GAS JOURNAL

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LOPSIDED POLICY

IT has been our custom for many years in these pages to subject the annual report of the Board of Examiners of the Institution Education Scheme to an analysis in the light of the industry's current needs and prospective developments. The report for this year, which was published in the *Journal* of September 28, is in many respects the most encouraging of all those which have been issued since the end of the war. It records a record entry of 639 candidates, which surpasses last year's total by 83, and compares most favourably with entries of between 450 and 500 in the immediate pre-war years. The Board also expresses satisfaction that, in general, there was a marked improvement in the standard as compared with last year in most grades, and that there is now a very high percentage of internal candidates.

There is, however, one aspect which is not in the least encouraging; there were seven Diploma awards in Manufacture—in Supply only one, and that a second class. This is no new development and was, in fact, commented upon by Dr. P. C. L. Thorne in his recent paper on technical education at the International Gas Conference. He said: 'There has been a rapid development in the technical requirements of the supply side of the industry during the last 25 years, but although the popularity of this branch has been reflected in the number of candidates in the lower ranges, few men have presented themselves for the Diploma in Gas Engineering (Supply).' Dr. Thorne rightly pointed to the weakness, but in our opinion he applied the soft pedal. It is true that technical requirements in gas distribution have developed apace, but that is not the whole of the matter; it is even more true to say that in the light of developments envisaged in the direction of interlinking and the regionalisation of gas supply there is not only a need for technicians with greater knowledge, but also for many more technicians skilled in the application of the principles of gas distribution at low and, more particularly, at high pressure. The fact that both the technical papers presented at the meeting of the North British Association of Gas Managers last month were concerned from different angles with the problems of centralisation is proof of the importance attached to this matter.

The remarks of the examiners on the standard of work submitted for the Higher Grade Certificate in Gas Engineering (Supply) also do not make happy reading. The standard, we learn, was lower than last year—regrettably low in the case of external candidates—and results were below expectations. More disturbing still, 'few candidates displayed more than a purely theoretical knowledge of the subjects chosen.' Only in the lower grade was there recorded an improvement both in the number of entries and in the general standard of work. Even then the answers to questions designed to test the students' initiative were disappointing. A much more even balance between the Manufacturing and the Supply side will have to be established and will have to be maintained. Working in larger units will equally mean the creation of a greater demand for specialists in many branches of gas manufacture. The fact remains that the gas industry still fails to recognise the supply side as of anything like the importance of that of the manufacturing side. And this is a mistake of first magnitude.

HIGH PRESSURE DISTRIBUTION

WITH the further development of urban areas resulting from a steady progress in post-war housing, the need for transmission of gas over comparatively long distances has greatly increased. More important, the inception of regional gas distribution schemes and attendant centralisation, facilitated by the nationalisation of the gas industry, call for a much greater use of storage and high pressure distribution. High pressure distribution is, indeed, an important topic of the day, and Mr. W. S. Johnston made a timely contribution to the meeting of the North British Association in describing the development of the high pressure distribution system at Dundee.

Dundee can claim with pride or otherwise to be the first city to have a district heating scheme in operation. Its gas undertaking, which, incidentally, is the fourth largest in the area of the Scottish Gas Board, can equally claim a place among the pioneers of high-pressure distribution. The first high-pressure main in Dundee was laid in 1910 to augment low-pressure supplies to areas in the city where an inadequacy of supply had developed.

Today, according to figures quoted by Mr. Johnston, 35 per cent. of the gas supply in winter months is pumped through the compressors, and over the peak hour period at mid-day 40 per cent. of the supply is at high pressure; in winter the daily output on the high-pressure mains is in the region of 3 million cubic feet, the compressors working 17 hours out of the 24.

In his paper, Mr. Johnston has provided a chronological summary of progress at Dundee in the form of 'a warning as to what should not be done,' and in the hope that there would be some aspects which could usefully be adopted in other undertakings. From his review it would appear that high-pressure distribution at Dundee, once installed, grew rapidly with the development of the city. Amalgamation of the Burgh of Broughty Ferry with the city in 1913 brought about the first major installation of 6,000 yards of high-pressure main from Dundee gasworks to Broughty Ferry gasworks. With this early start it was natural that further extensions should be made in the 1920's when housing development took place in areas not far from the routes of the high-pressure mains; extensions to the low-pressure system would have involved laying large mains through narrow streets already carrying as much underground plant as they could take. This period was concluded by the building of a new compressor house and the installation of two new compressors, completed in 1930. More recent developments have been the erection of a 3-lift spirally guided gasholder of 1 million cubic feet capacity at Lochee gasholder station, 1933, the installation of a third compressor in the compressor house, and the extension of a high pressure main from Barnhill to supply gas to the Monifeith gasworks one and a half miles away. Mr. Johnston has described these and other developments in some detail, and the technical methods and problems involved form a valuable record and guide for those who may in the near future be considering similar installations. His paper concludes with a personal expression of opinion on the replacement of district governors by district gasholders. Prime moving machinery, working at maximum capacity, should not be asked, he believes, to carry such a high proportion of the peak load as 40 per cent. He would prefer to see the high-pressure mains fill district gasholders at a fairly constant rate through volumetric governors or by some means of remote control, and let the holders take the load fluctuations. If all the district governors were to be replaced by suitably sited gasholders, the Bryan Donkin compressor at Dundee, working well within its capacity, could supply nearly 5 million cubic feet of gas daily into these holders, as compared with 3 million cubic feet now carried on the high-pressure mains in winter months. Clock controlling of the outlet pressures on the few district governors that might have to be retained would ensure some improvement in district pressures, and the filling of holders could be restricted to off-peak and night periods. The cost of gasholders compared with district governors and compressors would be justified at Dundee, and probably at other undertakings, by the fact that present holder capacity is well below that which is deemed desirable.

THE CARDIFF MEETING

TO an outsider the custom observed by the Wales and Monmouthshire Association of Gas Engineers and Managers of electing a President at an annual spring meeting and installing him at an autumn general meeting and of transacting most of the yearly routine business at the one and approving the statement of accounts at the other is a little confusing, but it does ensure a continuity of procedure and at the same time obviates an actual change of officers in the middle of the more elaborate and attractive social programme that characterises the May meeting. Last week's assembly at Cardiff was in the true September tradition—a day of golf, a morning of business, with a helpful discussion on distribution problems, the official luncheon, and an afternoon visit to one of the largest steel works in Great Britain. Mr. Harry Blythe, second only in the line of Presidents from the northern half of Wales, ended his year of office on the right note, and Mr. Darrell W. Rees, now an Alderman of the ancient borough of Pembroke and for some years Secretary of the Association, started his Presidential year in an atmosphere of enthusiasm which promises well for the gas industry throughout Wales.

This was the second meeting since nationalisation and, as in May when the then newly appointed Wales Gas Board Gas Engineer gave a paper on calorific values, the Council were fortunate in being able to arrange for Mr. W. T. Hird, the Board's Distribution Engineer, who moved from Sheffield to the Cardiff headquarters a few months ago, to present a short but provocative paper on distribution problems. The new President is to be commended on the speed with which the meeting disposed of the routine business to leave time for the discussion, the tenor of which must have more than satisfied the author, on whose shoulders will rest big responsibilities for distribution problems throughout Wales in the next few years.

District Associations naturally welcome a periodical visit by the President of the Institution of Gas Engineers. The disappointment at Mr. C. H. Chester's absence from the Cardiff meeting, however, was recompensed by the fact that Dr. W. T. K. Braunholtz, the ever-welcome Secretary of the Institution, who frankly prefers a minimum share of the limelight, deputised for the President in submitting the toast of the Association at the luncheon. In the course of his remarks Dr. Braunholtz summed up the position regarding the move towards turning the District Associations into District Sections of the Institution. To an Association which has such a large proportion of members (with a small 'm,' implying classes of membership other than those for which only chartered gas engineers are eligible) drawn from the contracting and appliance manufacturing side of the industry, the one possible stumbling block to such a change may well be a question of membership qualification. On that point the Council of the Association last Thursday renewed its pledge that it would seek arrangements whereby all existing members may remain in equivalent membership and that no major step would be taken without consulting the general body of members.

It would be difficult to conceive of a Wales and Monmouthshire Association confined solely to gasworks engineers and managers, for a great part of the unofficial and

social activity of the Association has been run for years by the 'trade' members. Under the new régime it would be equally difficult to think of an Association out of the closest and friendliest possible touch with the area board. Wales gas engineers have quickly taken their new administrators to their hearts and at their earliest opportunity last May they conferred Honorary Membership on Mr. T. Mervyn Jones, Chairman of the board, who last Thursday addressed the members not as a visitor but as one of themselves. That he is esteemed beyond the confines of the gas industry was evidenced by the Lord Mayor of Cardiff who, in replying to a toast at the official luncheon, paid tribute to his distinguished career in the municipal service, particularly as Town Clerk of Newport.

RESEARCH ASSOCIATIONS

ACCELERATION in the work of the State-aided research associations has been rapid since 1943, many new associations of the type having been set up. The movement as a whole since its inception in 1918 is the subject of review in the report for 1947-48 of the Department of Scientific and Industrial Research which has just been published. In spite of the progress, however, there is a note of warning in the report, which says that 'the chief factors limiting the development of the Department's plans have been shortage of staff and lack of suitable buildings.' In consequence the Department must leave undone many projects which are worthy of attention, and these, in general, are investigations of longer range. The major problem of policy is the balancing of the need for giving assistance on problems of immediate and pressing importance and the need for providing the basis for more far-reaching advances in industrial technique and practice.

Originally—and we go back to 1917—the plan was to establish the research association scheme by a fund of £1 mill. voted by Parliament. This sum was exhausted by 1932, at which time there were 20 associations spending £235,000 a year and receiving grants amounting to £68,000 a year. By 1939 there were still only 21 grant-aided associations, though their total annual expenditure had by then risen to £480,000, of which £170,000 was provided by the D.S.I.R. The position was reviewed in 1943 in the conviction that the scheme was fundamentally sound, and it was agreed that the principle of contemplating a time when each association would become entirely self-supporting without financial assistance from the Government should be abandoned. Examination into the whole question was made by the Industrial Grants Committee in 1943 and again at later dates, and several recommendations were made, most of which have, in fact, been implemented. One, for example, was for the permanent collaboration between the D.S.I.R. and the associations and the making of capital grants for major expenses such as buildings or unusually expensive equipment; and points of principle were firmly declared—among them the high degree of autonomy essential to the success of a research association, and the bridging of the gulf between development of a new technique and its adoption in works practice. The latter principle is elaborated in the report under review. It is not sufficient for a research association to produce results and disseminate them merely by the written word to its industry. Unless the results are applied, they serve but little purpose; and unless their implications are understood, they will not be applied in the works. The research worker responsible for a new technique must be familiar with works methods. It should be one of the essential services which a research association renders to the industry it serves that the transference of a new development from a laboratory to a works scale is carried out with the help of members of its staff adequately trained for such tasks. Close liaison is needed. There should be greater interchange of men between industry and the research associations to acquire on both sides a new mental approach. The report rightly emphasises that members of the staff of an association should work with the technical staff of industrial undertakings and so secure that the progress of an investigation is examined at each stage in the light of industrial practice.

THE GAS RESEARCH BOARD

THE research association of our own industry, the Gas Research Board, set up in 1941, is comparatively a newcomer in the field, and it is not among the wealthiest (in 1948 contributions from the then British Gas Council amounted to £40,700; Government grant was £28,000). But it can unreservedly claim to have implemented the recommendations of the Industrial Grants Committee. The Board is certainly in close touch with the technical staffs of the industry it serves. As exemplified in the research into the hardening of oxide, this has been done through the help which chemists and engineers throughout the country have given to the Board's investigators. In the total gasification and water gas investigations this help is being given by contractors, members of the Society of British Gas Industries. The Board has gone far to reconcile the two points of view of long-term and short-term research. And here we would recall the comments made by the Chairman, Dr. H. Hollings, at the annual luncheon of the Board earlier in the year, for they have such direct bearing on the problem of applying to practice the results of research and investigation. In the field of manufacture of gas up to the holder, said Dr. Hollings, the position is that expert technical knowledge based on past research work has reached a point at which it is necessary to take stock. A great deal of technical knowledge has already been accumulated, knowledge gained, indeed, before the setting-up of the Board. This technical knowledge, he pointed out, has gone a long way ahead of industrial and commercial application in the gasworks of the country; and the Council of the Board took the view that 'the more pressing matter for the industry is that the efficiency of all the works in the industry should be brought up to that established in a few of the best works.'

'Many of the tasks of research associations,' states the D.S.I.R. report, 'are common to all associations, and a sharing of experience can be of great benefit.' In this direction, too, we would point to the work of the Gas Research Board. In his latest report the Director, Dr. J. G. King, mentioned specifically the collaboration of

the Board with the British Welding Research Association (formed in 1946) and the British Ceramic Research Association (successor, in 1948, to B.R.R.A.); and liaison is, of course, firmly established with other associations—*e.g.*, the British Coke Research Association, the British Coal Utilisation Research Association, and the British Iron and Steel Research Association (the wealthiest association of them all)—and with the universities, notably Leeds University. And, on a broader plane, how does the Gas Research Board fit in with the activities of the Fuel Research Board? In this regard the D.S.I.R. report calls attention to the Fuel Research Board's study of the problem in 1946. It is contended that in this period of adjustment, precise lines cannot yet be defined in detail, though it is clear that with the development of the Gas Research Board there need be less emphasis at the Fuel Research Station on high temperature carbonisation. In general, the broad effect of this and other associations will be to enable the Fuel Research Station to concentrate more fully on basic problems in which the combustion of fuels of all kinds and the chemistry of fuels and their products will play a central part.

DOMESTIC HEATING REQUIREMENTS

IT will be recalled that in 1945 Messrs. Andrew, Dunning, and Holliday (then Watson House, Gas Light and Coke Company, now North Thames Gas Board) presented to the Institution of Gas Engineers an exhaustive paper (I.G.E. Comm. 278) bearing the title 'Technical Aspects of the Gas Industry's Contribution to Post-War Housing.' This paper had text-book dimensions and set out the results of teamwork investigation on the domestic use of gas. The authors stated that, for a house having living room, dining alcove, and kitchen on the ground floor and three bedrooms and bathroom on the first floor, all-gas service could be enjoyed for a consumption of 565 therms per annum. This service included cooking, space heating, water heating, refrigeration, and clothes airing. 'Heating Research in Houses' is the title of a paper by Dr. J. C. Weston, of the Building Research Station (published in the August issue of the *Journal* of the Institution of Heating and Ventilating Engineers), in which he gathers together many of the data so far obtained in the Abbots Langley heating experiment, the progress of which we have described from time to time in our pages. Dr. Weston remarks that the magnitude of the individual load for space heating and water heating (not including cooking, &c., it will be noted) is of great importance in connection with district heating schemes, particularly since it governs the weekly charges to be made to the tenant, and any error in computing may result in financial loss. Usual methods of computation, he mentions, give values ranging from 300 to 600 therms per annum for well-insulated houses, *but an additional open fire or gas or electric fire is usually proposed* (our italics). The figure of 565 therms given by Mr. Holliday and colleagues comprised 258 for heating, 155 for water heating (multipoint), the remainder for refrigeration, &c. At Abbots Langley the heat loss for a couple of well insulated houses averaged 710 therms per annum. Dr. Weston put down the miscellaneous gain in heat during the heating season, due to cooking, &c., as 100 to 150 therms. The heat required from the district heating station will, he maintains, be at least 680 therms, which is higher than is usually quoted. If we add the figure of 207 therms for cooking, water heating, &c., given in the Institution paper quoted at the beginning of this paragraph, we arrive at a total of approximately 900 therms per annum. Is there something wrong somewhere to account for the wide divergence in the findings of those working at Abbots Langley and those engaged at Watson House?

HIRERS' OBLIGATIONS

DURING last week the question was raised by Mr. B. Traill Thompson in a letter published in the *Daily Telegraph* of the obligations of hirers of domestic electrical appliances. A hirer of apparatus from the London Electricity Board is required to hold the Board indemnified against any damages, costs, expenses or loss which the Board may become liable to any person by reason of the use or misuse of the equipment or because of defects therein or in the wiring. Mr. Thompson described it as 'monstrous' that a nationalised business should impose a liability which is unlimited both in scope and the amount recoverable upon an unsuspecting public. There is, he pointed out, no escape for the hirer from claims for injury or damage arising from the negligence of the Board or its employees. 'Nationalisation,' wrote Mr. Thompson, 'was held out to be for the benefit of the public, but this indemnity clause leaves one with the impression that the first object is the protection of the Board'; and he urged that steps should be taken by nationalised concerns to amend clauses of this kind which will preserve the Common Law rights of the citizen and free him from carrying liabilities which properly belong to the nationalised boards and which can be fully covered by insurance. Replying in a subsequent letter, the Secretary of the London Electricity Board, Mr. W. H. Warhurst, remarked that the clause of which the complaint had been made is in accordance with ordinary commercial practice and is not a product of nationalisation. His own board, he pointed out, tries to assist consumers by advising them on wiring and apparatus; and he maintained that the number of accidents arising from the use of electricity in the home is 'extremely small.' This, of course, does not carry the matter very far. But Mr. Warhurst gave the assurance that Mr. Thompson's contentions would be carefully considered by the London Electricity Board and its legal and technical advisers. The question, we suggest, could well be ventilated in the deliberations of the electricity consultative councils.

UNIQUE OPPORTUNITY

NEW housing sites are springing up everywhere, generally adjacent to or an integral part of existing towns and the street lighting is usually supplementary to that already installed in the vicinity. Some of the new towns now contemplated under the Government programme, however, offer unique opportunities for planning street lighting installations for completely new areas. Harlow (Essex) appears to offer such an opportunity, and at the Association of Public Lighting Engineers' conference on September 15 Mr. W. H. Welch, Public Lighting Engineer attached to the Tottenham Division of the Eastern Gas Board, outlined his suggestions for a scheme complying as far as possible with the recognised practices and principles of public lighting. The Harlow Development Corporation has prepared a master plan for the new town and Mr. Welch based his suggestions on such information as was available about the plan at the time he prepared his paper. He was unable to say anything about the actual standard of lighting at present provided in the village around which the proposed new town is to be developed but he assumed that like other small communities the meagre yield of a penny rate was not likely to be capable of providing a high standard of lighting. The increased rateable value of the new town will not necessarily mean a large proportion for the local authority to spend on public lighting, but a reasonable sum invested in a first-class installation in the first instance may well prove in the long run to be an economical proposition. It is likely to be some considerable time before the town will have progressed sufficiently for street lighting to be installed, but the case for gas lighting seems to have been submitted to the Development Corporation at a sufficiently early stage to stake claims to provisional sites for public lamps, thus leaving the way clear for a straightforward erection of columns as and when required. Perhaps it should be added that the scheme which the author outlined in his paper was based on his own suggestions.

Personal

Mr. **F. R. Jenks,** Chief Draughtsman at Smethwick (West Midlands) has been appointed Chief Designer and Draughtsman, Sheffield and Rotherham Division (East Midlands Gas Board). Other appointments in the same division are: Industrial Gas Engineer, Mr. **F. Dickinson,** at present Industrial Gas Sales Manager to the Northern Gas Board (Newcastle Division); Deputy Industrial Gas Engineer, Mr. **F. J. Johnson,** at present Industrial Gas Engineer, South Western Gas Board (Bristol Sub-Division). Mr. **G. Davies,** at present Distribution Superintendent, Grimsby, has been appointed Distribution Superintendent for the North Lincolnshire Sub-Division.

Mr. **George Clark,** O.B.E., has retired at the age of 88 from his position as Chairman and Managing Director of the Bryan Donkin Co., Ltd., engineers, Chesterfield. Chairman of Chesterfield Gas Committee for 31 years, he played a prominent part in the development of the town's gas undertaking, and is a past Chairman of the Society of British Gas Industries. He will continue as a member of the Board and as Chairman of British Furnaces, Ltd., a subsidiary; Managing Director of Smith Bros. and Co. (Hyson), Ltd., Nottingham; and a Director of G. Waller and Son, Ltd., Stroud. He joined the Bryan Donkin Co., Ltd., in 1893 at Bermondsey and went to Chesterfield in 1900 as Manager of the local works. He became Director and General Manager of the Company in 1906, Managing Director in 1908 and Chairman in 1938. He has, therefore, played a great part in the growth and prosperity of the Company. The success it has achieved in the gas industry is largely due to his inspired leadership and personal endeavour over half a century. In recognition of his life's work on behalf of the Company, Mr. Clark was last January presented by his co-directors with a handsome portrait in oils. Mr. Clark will be succeeded as Managing Director of the parent company by Mr. **Lewis Seaman,** who has been Technical Manager for 20 years and a member of the Board since 1941. He is also a director of G. Waller and Son, Ltd., Stroud. Mr. **D. M. Henshaw** will become Chairman of the Board. He is Chairman of B.H.D. Engineers, Ltd., and has for 20 years been the nominated director on the Bryan Donkin Board for W. C. Holmes and Co., Ltd., Huddersfield.

Mr. **C. G. Grimwood** who, prior to nationalisation, was Chairman and Managing Director of the Sudbury Gas and Coke Company, retired from active service on Sept. 30 after 60 years in the gas industry. In 1889 he joined his father, who had been at the Sudbury works since 1868. At the end of his lease in 1909 the Directors of the Sudbury Gas and Coke Company decided to carry on the works themselves and appointed Mr. C. G. Grimwood Manager and Secretary. He became Managing Director in 1920 and Chairman of the Company in 1937. He leased the Wyvenhoe gasworks in 1899 and the Wyvenhoe Gas Company was formed in 1901, and Mr. Grimwood was Managing Director of that company also when the industry was nationalised on May 1. During his 60 years at Sudbury, gas sales have increased eight-fold, having risen from 12 mill. cu.ft. per anum in 1889 to 100 mill. last year. Works at Long Melford and Lavenham, which had been under Mr. Grimwood's control, were closed down and supplies were delivered from Sudbury. Mr. and Mrs. Grimwood celebrated their golden wedding in August of last year. Mr. Grimwood's son, Mr. **C. E. Grimwood,** now President-Elect of the Eastern Association of Gas Engineers and Managers, is carrying on as Engineer and Manager of the Sudbury District, Ipswich Division, Eastern Gas Board.

Mr. C. G. Grimwood (centre) with his son, Mr. C. E. Grimwood, and daughter-in-law.

Mr. **George Behr** has been appointed Manager for Ascot Gas Water Heaters, Ltd., for the territories covered by the Eastern, the North Thames, and the South Eastern Gas Boards.

This appointment coincides with Mr. Behr's association with the firm for a period covering over 21 years. He joined Cookers and Geysers, the precursor of Ascot, in 1927, and acted for some time as personal assistant to the late Dr. Bernard Friedman, the founder. In 1934, when the Ascot Company started to open branch offices to cover various areas of Great Britain, Mr. Behr was appointed London Sales Manager. He served with the Forces throughout the war, at first with the Army and then, from 1942 onwards, with the Royal Navy, being granted the rank of Lieutenant in 1943. In October, 1945, he re-joined Ascot Gas Water Heaters in his former capacity, a post which he has filled until his new appointment.

1949 'Journal' Directory

In order to keep the Directory information up to date, the following alterations which have been notified during the past month should be noted in the 1949 issue of the *Gas Journal Calendar and Directory:*

Page 70.—SPALDING: Delete W. J. G. Bryce *Dep. E.*
„ 70.—STAMFORD: C. W. F. Illingworth *E & M,* vice B. Clarke.
„ 82.—WILLENHALL: Delete W. G. S. Cranmer *D & S;* A. G. Cranmer *E & M becomes E, M & S.*
„ 92.—KILWINNING: Delete D. M. Rowan *E & M.*
„ 94.—NAIRN: D. M. Rowan *E & M,* vice T. M'Dougall.

Additions to the revised edition of the *Gas Board Personnel Supplement* have been published during the past month on pages 577 and 711 of the *Journal.*

Diary

Oct. 6.—'Gas in the Design for Living' Exhibition, the Building Centre, Conduit Street, London, W.1. Address by Sir Edgar Sylvester, K.B.E., F.C.A., Chairman of the Gas Council.

Oct. 7.—North of England Gas Managers' Association: Autumn meeting and visit to Willington coke ovens of Brancepeth Gas & Coke (Strakers and Love), Ltd.

Oct. 7-9.—Association of British Chemical Manufacturers: Chemical Works Safety Conference, Scarborough.

Oct 8.—Yorkshire Junior Gas Association: Annual General Meeting, Hotel Metropole, Leeds, 2.30 p.m.

Oct 11.—Midland Junior Gas Association: Birmingham. Presidential Address of S. C. Bentley.

Oct. 11.—Illuminating Engineering Society: Opening Meeting. Presidential Address, J. N. Aldington, B.SC., PH.D., F.R.I.C., Royal Society of Arts, John Adam Street, 6 p.m.

Oct. 18.—Southern Association of Gas Engineers and Managers (Eastern District): 'Gas Distribution—Modern Methods of Control,' T. W. Aiken (Chief District Engineer) and B. I. Stone (Assistant London Manager), the Bryan Donkin Co., Ltd., Gas Industry House, 2.30 p.m.

Oct. 19.—Society of British Gas Industries Golf Circle: Autumn Meeting, Fulwell Golf Club, Hampton Hill, Middlesex.

Oct. 20.—London and Southern Junior Gas Association: Meeting, Gas Industry House, 7 p.m. Paper, 'The Cost of a Domestic Hot Water Service by Gas,' by C. H. Purkis.

Oct. 25.—Southern Association of Gas Engineers and Managers: Autumn General Meeting. Presidential Address, J. H. Dyde. Connaught Rooms, 2.30 p.m.

Wales and Monmouthshire Association

Secretary Inducted as President at Autumn General Meeting at Cardiff

THE Autumn General Meeting of the Wales and Monmouthshire Association of Gas Engineers and Managers was held at Cardiff on Sept. 28, when, on the completion of his year of office as President, Mr. H. Blythe (Colwyn Bay) inducted his successor, Alderman Darrell W. Rees, M.B.E. (Pembroke), into the Chair. The business meeting was held at the South Wales Engineers' Institute and was, as usual, very well attended.

Mr. **Blythe,** in opening the meeting, extended a warm welcome to Mr. J. S. Smith, O.B.E. (Ministry of Fuel and Power), Dr. W. T. K. Braunholtz, O.B.E. (Secretary of the Institution of Gas Engineers), Alderman J. E. Emanuel (part-time member of the Wales Gas Board), and a number of students who were later to receive certificates. Mr. T. Mervyn Jones, M.A., LL.M. (Chairman of the Wales Gas Board) arrived a little later and was given a hearty reception.

With regret it was announced that apologies for absence had been received from Mr. C. H. Chester, O.B.E. (President of the Institution of Gas Engineers), Mr. R. Kelf-Cohen (Ministry of Fuel and Power), Dr. A. B. Badger (Industrial Relations Officer of the Gas Council), Mr. R. J. Auckland (Cardiff), Mr. E. M. Edwards (member of the Wales Gas Board) and the Presidents and Secretaries of the kindred District Associations.

Especial regret was expressed at the absence of Mr. K. E. Tiddy (Carmarthen), who should have taken over the duties of Secretary from Alderman Darrell Rees. Mr. Tiddy's absence was due to the death a few days earlier of Mrs. Tiddy, and a message of sympathy was sent to him.

New President Inducted

The audited accounts for 1948-49 having been approved, Mr. **Blythe** asked his successor to take the chair, and said he did so with the full assurance that Alderman Darrell Rees would make an efficient President and would receive the full co-operation of the Council and members.

Alderman **Darrell Rees** acknowledged the honour bestowed upon him and said that in accordance with tradition his first pleasant duty was to present a silver salver to the retiring President. Never in the long history of the Association had the gift been more richly deserved. Mr. Blythe had long been actively associated with the organisation of gas engineers and managers in North Wales, and since North and South had become united in the one Association there had been magnificent co-operation.

Mr. **Blythe** briefly returned thanks.

Mr. **R. O. Roberts** (Prestatyn), Acting Secretary, reported that draft rules for the conversion of the District Associations into District Sections of the Institution had been examined by the Council, who wished to renew the pledge given at the May meeting that they would press for some form of membership for all those who were at present members of the Wales and Monmouthshire Association. The Council had asked the President and Secretary to attend the next joint meeting of representatives of District Associations. Before any major decision was taken, due notice would be given to all members.

On the proposition of Mr. **T. R. Evans** (Cefn Mawr), seconded by Mr. **A. Mawson** (Caernarvon), Mr. W. T. Hird (Distribution Engineer, Wales Gas Board) and Mr. H. H. Watson (Llangefni, Anglesey) were elected members of the Association.

The **President** then presented certificates (tokens of book prizes which are to be forwarded to the recipients later) to the Wales students who were successful in this year's Institution of Gas Engineers and City and Guilds of London examinations. The Association, he said, was proud of the lead which the late Mr. Octavius Thomas gave in regard to the recognition of such successes, and he wished all the students every success in their future careers.

Mr. **W. T. Hird** (Distribution Engineer, Wales Gas Board) presented a paper on 'Some Thoughts on Distribution,' which produced a very full discussion. The paper and a report of the discussion will be published in a later issue of the *Journal*. A vote of thanks was accorded to the author on the proposition of the President, seconded by Mr. J. F. Rust (Newport).

The District Bodies

The meeting was followed by the official luncheon at the Park Hotel, Cardiff, at which the principal guests included Alderman T. J. Kerigan, J.P., Lord Mayor of Cardiff.

Dr. **W. T. K. Braunholtz** (Secretary of the Institution of Gas Engineers) proposed the toast of the Wales and Monmouthshire Association and conveyed to the members the greetings and good wishes of Mr. C. H. Chester, President of the Institution, who regretted his inability to attend, but hoped to see them on a future occasion.

The District Association and the Institution were voluntary organisations which existed solely for the mutual benefit of their members and for the good of society in general, and they fitted naturally into the wider picture drawn by the Chairman of the Gas Council in his encouraging address at the annual meeting of the Institution in June: 'Just as in the larger world of nations and societies, our organisation must depend for its development on the creative spirit of the individuals who comprise it, and on the co-operation between those individuals for the common good.'

There had been a good deal of exploratory discussion recently regarding future relations between the District Associations and the Institution. The object of those discussions was solely to ensure that their collaboration in the future should be closer and more fruitful than in the past.

Most large chartered institutions had local sections which facilitated the coming together locally of the members and the discussion throughout the country of matters of common interest to all, and it was natural that the suggestion had been made that it might be appropriate for the District Associations to become District Sections of the Institution of Gas Engineers.

Details to be Settled

From what he had heard—and it would not be proper for him on that occasion to go further into the suggestion—the idea had received general approval, while matters of detail had still to be settled. He emphasised that the Institution was not attempting to persuade any District Association to become a District Section—that was a matter the Association must decide for itself, and it must take the initiative. The by-laws of the Institution empowered the Council to set up District Sections wherever and whenever a sufficient number of members applied to the Council for that to be done, but the Council could not and would never do so until it received a request from the members in the Districts.

He also emphasised that there was no suggestion that if a District Association became a District Section there would be the slightest change in the local flavour or tradition of the Association. The Council of the Institution attached importance to fostering a unity of spirit in the industry, and to that end one of the prime objects in starting the Institution Bulletin had been to interest the members up and down the country in the day to day work of the Institution. He believed there was a great future for the Districts.

Alderman **Darrell Rees,** the new President, briefly responded and thanked the Association for the honour bestowed upon him. He had served the Association to the best of his ability for some years as Secretary and he would do his best to discharge the Presidential duties with dignity and decorum.

Early Gas History

Mr. **T. Mervyn Jones,** Chairman of the Wales Gas Board, proposed the toast of 'The Future Prosperity of the City of Cardiff.' He apologised for the absence of his full-time colleagues, Mr. R. S. Snelling and Mr. E. M. Edwards, but welcomed four of his part-time colleagues—Alderman G. F. Hamer, High Sheriff of Montgomeryshire, Mr. J. C. Clay, Mr. F. Price and Alderman J. E. Emanuel. The City of Cardiff, he suggested, had a big interest in gas. As early as 1767, 32 years before Murdoch's discovery, the Most Rev. the Lord Bishop of Llandaff, Dr. Richard Watson, was examining the whole nature of the distilled products of coal, including gas, and it was fitting that a successor in title and office to the great See of Llandaff had quite recently been enthroned as Archbishop of Wales. The gas industry emerged in a more tangible form in Cardiff in 1836, with 63 consumers against the present 74,000. Before the

town became a city it consumed about 1,000 mill. cu.ft. a year, and by 1948 the consumption had increased to more than 3,000 mill. cu.ft. More than 30% of the gas produced in the city was used in industry, and Cardiff was now supplying gas to neighbouring towns.

Alderman **T. J. Kerrigan,** J.P., Lord Mayor, responded and congratulated Mr. Mervyn Jones on his appointment as Chairman of the Wales Gas Board and wished him many years of happy service in his high office. He recalled his great contribution to local government during his period as Town Clerk of Newport.

The Guests

Mr. **W. Clark Jackson** (Neath) proposed the toast of the guests and referred especially to the presence of members of the Wales Gas Board, Mr. J. W. Davies, of the Ministry of Fuel and Power, Cardiff, Dr. Braunholtz, and Mr. J. B. Deakin, Works Manager of Guest Keen Baldwins Iron and Steel Co., Ltd., whose works were to be visited in the afternoon. He coupled with the toast the name of Mr. J. S. Smith, of the Ministry of Fuel and Power—'the Civil Servant par excellence.'

Mr. **J. S. Smith,** in a humorous response, spoke of the friendly relations existing between the Association and the Ministry.

Visit to Coke Ovens

In the afternoon a large party of members visited the works of Guest Keen Baldwins Iron and Steel Co., Ltd., particular interest being taken in the Becker coke ovens. In addition to that used on the works a large quantity of coke oven gas is supplied to the Cardiff gas undertaking for use in Cardiff, Newport, and Barry. At the end of the tour the visitors were entertained to tea. Their thanks were voiced by the President and acknowledged on behalf of the Company by Mr. J. B. Deakin, Works Manager.

Golf Competition

The day before the business meeting —Sept. 28—was devoted to golf on the excellent course of the Radyr Golf Club. The competition for the Dean Cup occupied the morning, and in the afternoon there was an 18-holes friendly four-ball match. Best scores in the bogey singles were as follows:

J. P. Smith	...	2 up.
A. L. Thomas	...	all square.
Darrell Rees	...	1 down.
E. Aspinall	...	1 down.
T. Mervyn Jones		4 down
A. Sadler	...	4 down

The Dean Cup and trophy and the runner-up trophy were presented to Mr. Smith and Mr. Thomas respectively by the **President** at the close of the official luncheon.

There was Little Change in the output of coal during the week ended Sept. 24. The total output was 4,235,100 tons, 1,800 tons below last week's figure. Tonnage of deep-mined coal lost through disputes rose to 55,400 tons. Manpower figures for the week ended Sept. 17 declined by a further 700 to 715,100, the number of faceworkers remaining unchanged. The total of gas available at gasworks for the week ended Sept. 23 was 9,000.6 mill. cu.ft.

North British Association Bowls Results

The annual bowling competition of the North British Association of Gas Managers was held on Sept. 14, at Granton Bowling Club, Edinburgh, when 56 players took part. During the afternoon, Mrs. D. D. Melvin, wife of the President of the Association, entertained the ladies to afternoon tea, and later she presented the trophy and prizes to the winners.

Winners: 1. W. Phairn (Lanark). 2. J. MacLusky (Halifax). 3. J. Brown (Glasgow). 4. A. L. McLean (Dunslane (skip) 15 shots up.

Runners up: 1. E. Shiell (Innerleithen). 2. J. Scobie (Stonehaven). 3. J. G. Muscroft (Sheffield) 4. H. Macpherson (Newmilns) (skip) 10 shots up.

Following the presentation of prizes, Mr. **C. J. Gregg,** President of the Bowling Club, in a few well chosen words, paid tribute to the work which had been done by the Hon. Secretary and Treasurer of the Club, Mr. Thomas Thomson, who has acted in this capacity for the past 16 years. On behalf of the members he had pleasure in asking Mr. Thomson to accept a silver salver and tea service as a token of their thanks.

Mr. **Thomson** suitably replied and expressed his warmest thanks to the President and members of the club for their handsome gift.

Mr. J. W. Beveridge, of Troon, was elected President for 1950.

In our series of North British Association photographs, p. 770, we regret that Mr. J. Thow was through a printer's error referred to as Mr. Thew.

N.B. ASSOCIATION *MELROSE ABBEY, SEPT. 16*

Simmering Gasworks

Gas Supply in Vienna, 1899-1949

THE gasworks at Simmering was put into operation on October 31, 1899, thereby inaugurating the municipal supply of gas in Vienna, which was then one of the first cities in the present Austria to have the supply of gas under its own control. Only in four other towns—Feldkirch, Leoben, Stockeran, and Bregenz—had the works been transferred from private to public ownership before that date.

The supply of Vienna with gas dates back to 1830, when the Austrian Gas Light Company erected the first gasworks in the suburb of Rossau, to be followed five years later by another works at Fünfhaus. At the same time an English gas undertaking [the Imperial Continental Gas Association, London] secured the monopoly of gas supply by long-term contracts with the municipal authorities of Vienna and those of its communes. In the course of years the number of works increased to nine, which were operated by the two organisations within the boundaries of the city.

The City Council realised at an early date the importance of having the gas supply under its own control and commenced to prepare plans as far back as 1872. After a long struggle extending over many years, the Council passed a resolution, proposed by the then Burgomaster, Dr. K. Lueger, on October 28, 1896, to take the gas supply of Vienna into its own hands and to build a gasworks. Three years later this was put into operation and commenced to supply on October 31, the day when the contract with the English gas undertaking expired.

The erection of a new works and the simultaneous laying of 435 miles of mains, together with the modernisation of the street lighting in the districts, constituted an achievement which commanded the admiration of the whole gas profession and reflected great credit on the then Chief Municipal Engineer, F. Kapaun, who later became Chief Engineer and Manager of the municipal gas undertaking.

The works at Simmering had a capacity of 15.3 mill. cu.ft. The gas was produced in Coze inclined retorts, arranged in 18 sections of 10 settings of nine retorts. Each of these retorts was charged with 3½ cwt. of coal four to five times in 24 hours. The settings had single generators and were equipped with recuperation.

Soon after the transfer of the gas supply to municipal ownership a rapid increase in gas consumption took place, as elsewhere, largely due to the introduction of incandescent lighting, the invention of the Austrian chemist Auer von Welsbach, (in 1885). The expansion continued when gas began to be used more and more for cooking and heating, the lighting load having been transferred to electricity which, gradually at first but rapidly later, conquered this field through the metal filament lamp, another product of the same inventor.

In 1904 the works had to be enlarged, and a water gas plant of 3½ mill. cu.ft. capacity was erected. Four years later another extension became necessary, and 15 Koppers inclined chamber ovens of 7 tons capacity were built, to which another 19 were added in the following year, thus finally increasing the potential output of the works by 28 mill. cu.ft. The ovens were heated with producer gas generated in outside generators of the Duff type, fitted with 'Pult' grates. The gas was freed from coarse flue dust in dust catchers and supplied hot to the setting. The greater purity of the gas and the easier control of the settings brought in its wake not only improvements in the economic operation of the settings, but also an increased life of the latter.

In 1909 Franz Menzel became Engineer and Manager, who since 1896 had been responsible for the building of the Simmering works and later controlled the development and constructional department of the municipal gas undertaking. He, a man of high calibre and outstanding personality, laid the foundations of Vienna's gas supply as it exists today. His pioneer work, in which he had the assistance of collaborators such as Bössner, Marischka, Güntner (his successor), and Seitz, the chief constructional engineer, proved to be of international importance.

Through Menzel's initiative a battery of Koppers horizontal chambers was erected at the Simmering works in 1910 and

marked the beginning of the change-over from gasworks to coke ovens. In 1909 Innsbruck had taken a similar step, but the ovens were still equipped with recuperators, whereas those at Simmering were fitted with regenerators. The installation proved the forerunner of many similar ones at a number of gasworks on the Continent.

The guarantee conditions imposed by Menzel were very hard for those days. Not only was a low fuel consumption demanded, which was to include the energy required by the producers, but the use of small coke was also stipulated. Koppers proposed the erection of Kerperly producers with rotary grates, generating low pressure steam of 6 atm. (88 lb./sq. in.). The recovery of the sensible heat of the producer gas was thereby achieved, but the firetubes used in the construction showed various defects. They were successfully replaced by water tubes on the proposal of C. Marischka and A. Seitz, which proved their advantages at a second gasworks erected in Vienna as well as in installations abroad.

The coke oven battery at Simmering was designed for an output of 1.75 mill. cu.ft. in 24 hours and consisted of 18 chambers, each carbonising 10 tons of coal in 24 hours. At the end of 1911 the Simmering works had reached a daily capacity of 660,000 cu. m., 23.3 mill. cu.ft., representing 1½ times the potential output of the works in the first year of its existence.

Pioneer Plans and Plants

When the contracts with the two private gas undertakings expired, it became necessary to build a second works. Preliminary work was started in 1908, and building operations commenced in the following year. The new works, built according to the plans of engineers working under Menzel's direction, were completed in just under 2½ years. They are situated at Leopoldau near the north railway line, which connects Vienna with the coal basin of Ostrau Karwin, at that time the only source of supply of the city's coal.

Horizontal chamber ovens, on account of their superiority to horizontal retorts and inclined chambers, were chosen for the new works, which were equipped with, at the time, the most modern coal and coke handling plant. They had an initial capacity of 8.8 mill. cu.ft. in 24 hours and started gas supply on December 18, 1911, by which date the necessary connections to the distribution systems of the two gas companies had been made.

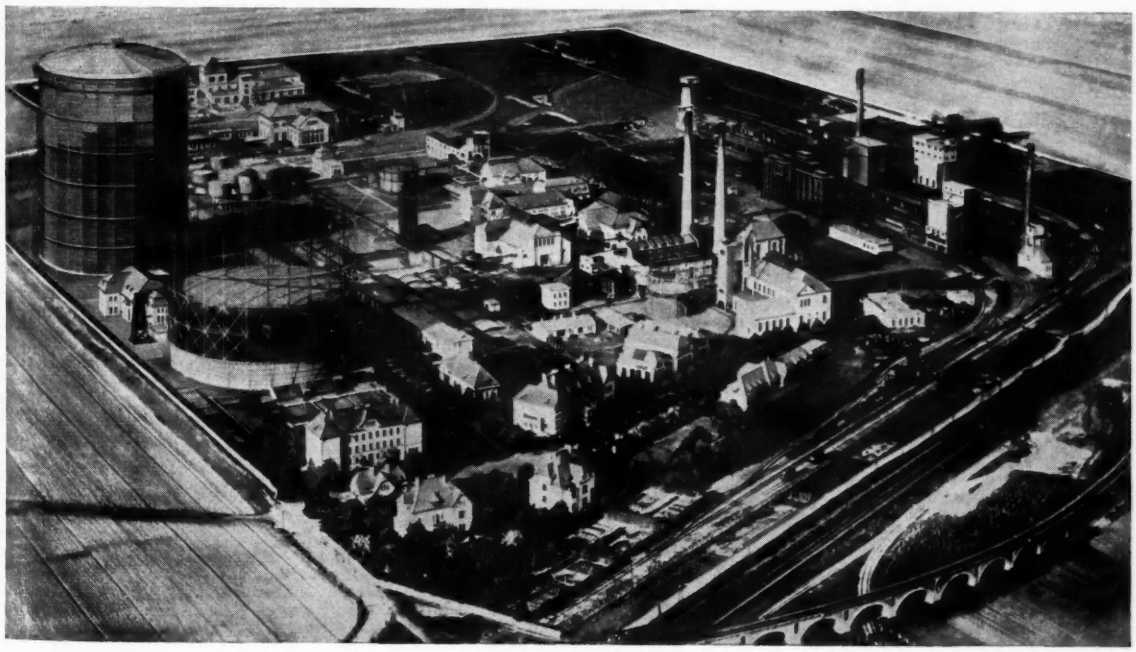
Thus the whole of Vienna's gas supply came under the municipal régime with the exception of an area in the south-west, which continued to be supplied by the Austrian Gas Light Company from their works at Wienerberg.

By 1912 the total production capacity of the Vienna gas undertaking amounted to 32 mill. cu.ft. a day which in the course of the year was increased to about 35 mill. cu.ft. by an extension of the horizontal chamber ovens at Simmering. The plant sufficed until the outbreak of the first world war, when the gas consumption increased tremendously. In 1915 a trial di-gas plant with a daily output of 378,000 cu.ft. was erected at the works at Simmering, while at the Leopoldau works a battery of compound coke ovens was built.

In 1917 the shortage of coal made it necessary for the first time to curtail the gas supply. With the breaking up of the Austrian State at the end of the war, the Ostrau-Karwin coal basin was lost as a source of supply of coal, and likewise deliveries from Silesia ceased. To prevent a complete collapse of the gas supply, it became necessary to limit the consumption of gas for domestic purposes to 35.3 cu.ft. in 24 hours and to restrict drastically its use for commercial and industrial purposes.

In previous years the reduction of the calorific value of the gas had already proved a useful measure. Originally, a mixture of coal and carburetted water gas was supplied from

EDITOR'S NOTE :—This exclusive abstract translation is from a paper given recently to the Austrian Association of Gas and Water Engineers by Dr. J. Dollinger, Director of the Vienna gasworks. It indicates the pioneer work of the Vienna undertaking during the past 50 years, recalls the enterprise of engineers famed in the world gas industry, recounts difficulties of no mean order overcome by no mean skill. The original paper was published in full in *Gas, Wasser, Warme*, 1949, 133-144.



Leopoldau Gasworks

Simmering works, but the Leopoldau works, having no water gas plant, produced straight coal gas. The calorific value in each case was on an average 556 B.Th.U. per cu.ft. During the war the calorific value of the gas was reduced by adding water gas at the Simmering works and producer gas at the Leopoldau works. Notwithstanding objections to the latter on account of the increase in inerts, which were raised particularly by the German gas industry, the practice caused no inconvenience to either domestic or industrial consumers, provided the properties of the gas remained consistently the same.

Inter-War Years

When after the first war a calorific value standard of 440-472 B.Th.U. was adopted, the gas undertaking at Vienna supplied a mixed gas of this calorific value, until during and after the second world war further drastic alterations became necessary. After the first world war coal deliveries to the Simmering works were interrupted for a considerable time, and did not appreciably improve until 1920, so that the restrictions in the supply of gas were not removed until March, 1921, but even then the consumption did not improve much owing to the prevailing economic conditions and the high cost of gas installations. An energetic propaganda campaign, however, proved successful, so that in 1924 gas consumption increased by 22% over that of the previous year.

In the same year difficulties arose in the sale of coke both at home and abroad, which were only relieved for a brief period during the miners' strike in England in 1926. The difficulties were increased through the import of large quantities of metallurgical as well as domestic coke into Austria, causing considerable sums of money to be tied up through the storage of the surplus coke, apart from providing the necessary storage space and transport facilities. The management tackled these difficulties energetically by improving the coke quality through the installation of coal grinding mills and mixing tables, thus increasing its saleability, by the installation of a water gas plant of a daily output of 5.65 mill. cu.ft. at Leopoldau, and by the erection of a carburetted water gas plant of 1.82 mill. cu.ft. daily capacity at Simmering in order to find an outlet for the surplus production. These steps were accompanied by embarking on a systematic sales campaign and by providing facilities for consumers to acquire coke boilers and slow combustion stoves of the gas undertaking's own design or of reputed makers at cash or on hire-purchase terms. The coke market, however, did not improve materially until 1932, when fuel laws were promulgated which made it compulsory to use a certain proportion of home-produced fuels.

While the coke market improved, the sale of gas fell after 1930 in consequence of the deteriorating economic conditions. In these circumstances the compound ovens, first introduced in 1915 and used in all extensions of the carbonising plant, proved their value. Net gas sales fell from 11,200 mill. cu.ft. in 1931 to 8,950 mill. cu.ft. in 1937, but the consumption of coal was kept almost constant by increasing the use of gas for heating the ovens and thereby raising the yield of coke from 317,000 tons to 441,000 tons or from 48% to 63% of the weight of coal carbonised.

Ravages of World War 2

At the outbreak of the second world war the combined potential output of the two works had reached 53 mill. cu.ft. of mixed gas in 24 hours, which in 1943 was brought up to 57.2 mill. cu.ft. by the erection of 30 Otto ovens, producing 4.25 mill. cu.ft. of coal gas per diem. Further additions to the carbonising plant in 1943 and 1944 (44 Koppers hair-pin ovens at Leopoldau and 25 Otto ovens at Simmering) had not been completed at the end of the war. The oldest battery at Leopoldau had been badly damaged in an air raid in 1944, and after temporary repairs had to be put out of commission in March, 1945.

Further numerous air raids, and particularly the fighting in Vienna in April, 1945, brought gas production to a standstill. Last year a battery of 30 ovens, which had been put out of action towards the end of the war, was restarted with much difficulty, while another new battery of 25 ovens was completed at the same time. Thus, the total daily capacity of the Vienna gas undertaking rose to between 46 and 49.5 mill. cu.ft., including the addition of an average of 4.95 mill. cu.ft. of natural gas.

At first sight natural gas appears very attractive. It consists mainly of methane and hence possesses a high calorific value. Moreover, as it is an indigenous product, it replaces imported coal. Technically the proposition is not without its difficulties. The quantity of gas available fluctuates so that the composition of the gas supplied to the district undergoes constant changes. In any case, natural gas must be diluted with twice its volume of producer gas in order to obtain the standard calorific value of town gas of 495 B.Th.U. per cu.ft. This is preferred to water gas, as the production of the latter consumes more coke than that of producer gas and increases the toxicity of the resultant town gas. On the other hand, producer gas raises the inert content, while at the same time it reduces the hydrogen and the flame propagation of the mixed gas. These drawbacks made themselves felt in its use, and accidents became more frequent. On account of the shortage of holder capacity, it was also difficult to maintain a steady calorific value of the gas sent out, which often showed variations of up to 21 B.Th.U. In addition, there was the reduction in the yield of by-products, a quantity of which had to be imported.

Recovery of By-Products

The Vienna gas undertaking always endeavoured to keep up-to-date with the recovery of by-products and purification, and, indeed, was often leading the way. It was probably the first undertaking on the Continent to erect oxide purifiers in the open, resulting in considerable savings in first costs, operation and transport. Contrary to the usual custom, naphthalene was washed out with gas oil instead of the more expensive tar oil, which also was difficult to obtain.

Coke quality always received its full attention. Before the war both domestic and foundry coke were produced, to which was added after the war blast furnace coke of a shatter test of 80. The recovery of benzole was introduced during the first world war. After the erection of a fractionating column, pure benzene, toluene and xylene were produced, which were not only sold to the chemical industry at home, but were also exported in appreciable quantities after 1923, thus providing a means of acquiring foreign exchange. The ammoniacal liquor recovered was converted into sulphate of ammonia as well as into ammonium bi-carbonate and liquor ammonia. At present, the shortage of sulphuric acid and war damage to the ammonia plant at Leopoldau which also has a sulphuric acid vanadium contact plant, constitute a great handicap, but the plants in question are being repaired at the present moment.

At one time the spent purifying material was extracted with tri-chloro-ethylene, but the process, which was in the nature of an experiment, was abandoned, as the recovered sulphur only found limited use, although its purity was over 99%. The plant suffered extensively from corrosion due to the formation of hydrochloric acid, while the extracted purifying material proved unsuitable for further use. The spent material was, therefore, sold to the chemical industry, and at present goes to the paper industry.

The chemists at Simmering have recently developed a process by which sulphuric acid is produced from the spent oxide, the latter being recovered for re-use as purifying material. A semi-large plant is in the course of erection.

The laboratories not only exercise control of the process of gas manufacture, but also do an enormous amount of research. For many years past the question of detoxification of gas has been studied. In 1927-28 a semi-large scale plant was erected at Simmering*, where a process developed by Professor W. J. Müller was tried out. Other experiments were conducted jointly between the Vienna gas undertaking and Professor A. Klemenc at the University of Vienna. Finally, a plant dealing with 17,600 cu.ft. in 24 hours worked for some time, operating on the principle suggested by Bössner and Marischka†, two of our works superintendents. Although the carbon monoxide content of the gas at Vienna is only 13% to 14% and is thus lower than in many other cities and towns accidents have not been infrequent, particularly immediately after the war. Although their rate has gone down, we continue to devote much time to this question and pay every attention to work done on the subject abroad.

In this connection mention should be made of the work done with regard to accident prevention which was carried out at the Institute of Hygiene by Professor R. Grassberger at the instigation of the Vienna gas undertaking and of the Central Bureau for Gas Usage, Berlin. The investigations have been recorded in a number of publications, among which are that on the 'Odorisation of Town Gas' and that on the 'Pollution of the Atmosphere of Rooms Through Gas Appliances.'

* Ost. *Chemiker Ztg.*, 1935, 81.

† *G.W.F.* 1939, 432 & 774.

Development work has included a new process* for the removal of hydrogen cyanide from coal gas and a low temperature gas producer with by-product recovery, designed with the special object of utilising indigenous brown coal.

I should like to show the relationship between production and the number of employees over the past 50 years. The production curve runs parallel to the consumption curve except for the periods during which coal gas was used for heating the ovens. During the first 11 years the average number of employees amounted to 2,100, and rose to 2,800 when the Leopoldau works were opened. It reached a maximum in the 'forties, when the works at Wienerberg, Mödling, Wiener-Neudorf, and Troiskirchen were absorbed, but has fallen since.

The personnel required per mill. cu.ft. of gas produced has been reduced from 0.82 in 1901 to 0.27 in 1948.

Gas Distribution

Simultaneously with the erection of the works at Simmering a new low pressure distribution system was installed. Feeder mains of 47.5 in. diameter supplied the actual district mains, which in anticipation of an increase in the consumption of gas were of relatively large dimensions, having a mean diameter of 13 in. and a length of 338 miles. Extensions to other districts and the absorption of the two private gas companies brought the total length of mains up to 435 miles. The latter two distribution systems, however, consisted mostly of small mains which made it impossible to ensure a satisfactory gas supply at low pressure. For this reason steps were taken in 1913-14 to raise the gas pressure and to equip the distribution system with the necessary boosters and governors. At the same time the two manufacturing stations were connected up. Between 1930 and 1934 the smaller mains were replaced by larger ones so that the mean diameter of the mains was increased from 10.2 in. to 10.4 in. The linking up of the Wienerberg works and the smaller works in the Southern districts brought the total length of mains up to 1,240 miles, but at the same time reduced the mean diameter of the mains to 10.2 in.

The present day distribution system consists of feeder mains of 28.4 in. diameter, which supply a ring main encircling the inner districts with gas at a pressure of 11.8 to 19.6 in. From the ring main a number of branches lead to the outlying districts. The medium pressure system, which has a total length of 88.5 miles, is connected to low pressure mains through about 50 automatic district governors. The gas boosters are partly installed at the gas manufacturing stations and partly at the holder stations, Brigittnau and Baumgarten. The inner districts have retained their low pressure distribution system with its large diameter mains.

The gas pressure in the somewhat complicated distribution system, which possesses considerable differences in level, is controlled by distant operated governors. †A special feature of the system are the dust arresters developed by our distribution engineers and installed in conjunction with the district governors and at many points of the medium pressure system. Future work concerns the replacement of mains of small diameter and of those which received only temporary repairs after war damage.

Gas Consumption and Utilisation

The number of consumers rose from 62,000 in 1900 to 122,000 in 1911, and amounted to 240,000 at the beginning of the first world war. As the result of extensive propaganda it increased to 500,000 in 1932 and later reached a maximum with 580,000. At present only 545,000 consumers are supplied, but their number is rising again.

The installation of dry gas meters commenced in the 'twenties and gradually replaced wet meters almost completely. Between 1905 and 1920 70,000 prepayment meters were installed, but their further use was discontinued on account of the ever-changing price of gas resulting from the inflation. Soon after the beginning of the second world war it became increasingly difficult to replace defective meters, and the gas undertaking was obliged to connect consumers direct to the mains and charge them a fixed rate. The number of such consumers still amounts to 43,000 at present. The difficulties through these, particularly from an economic aspect, have been enormous, but the meter works are beginning to obtain the necessary raw materials again, so that the fixed rate consumer will gradually disappear.

Originally, gas used for lighting and that used for heating were charged at different rates, but in 1907 a uniform tariff was introduced. Already during the first 11 years the gas consumption rose rapidly and further increased in 1912 through the absorption of the two private companies. A further increase in gas consumption was experienced during the first world war through war industries, but was followed by a considerable drop after cessation of hostilities as coal became scarce. After the rationalisation of gas production, consumption rose but slowly. For this reason an intensive sales campaign was started under Chief Inspector Günter, who introduced a renting and a hire purchase system for gas appliances, which together with lectures and exhibitions gradually increased the number of both domestic and industrial consumers. These measures were favoured by an improvement in the economic condition of the country between 1924 and 1931, so that the gas consumption rose by 80% in these years.

In this connection the formation of a co-operative body in 1934 must be mentioned. The gas undertaking, plumbers, and manufacturers of gas appliances combined primarily for the purpose of creating work by carrying out gas installations on the instalment system. The turnover increased rapidly and amounted to £120,000 during the fourth year after the inception of the scheme. It was discontinued at the beginning of the last war, but has been resumed again and proves extremely successful.

From 1926 onwards the gas consumption by commerce and industry has been recorded separately. In the 'thirties about 80% of the total amount of gas sent out was sold to domestic consumers and public institutions, while 15% went to industry and 4% was used for public lighting. During the recent world war the ratio changed to 70:30, while the consumption of gas for street lighting became *nil* owing to the restrictions imposed under A.R.P. At present the amount of gas used for cooking and heating is about 85% of the total sold; the balance of 15% is accounted for by industry. The latter is increasing. During the first 20 years the annual consumption was of the order 2,824 cu.ft. per head, but then rose to 5,648 cu.ft. After a drop during the economic crisis, it further increased to 7,236 cu.ft. In 1938 the figure stood at 6,530 cu.ft. and is probably higher than in any other large city of the Continent.

Price Fluctuations

It is worth noting that the total gas consumption in 1946 and 1947 exceeded that of pre-war days and reached 11,720 mill. cu.ft. in 1948—i.e., 30% more than the amount of gas sold in 1937. The progress continued. The gas consumption in the first quarter of 1949 was 13% higher than that of the corresponding period of the previous year. It is difficult to find an adequate explanation for this increase. It is a fact, however, that more gas is used for heating and, further, that people take more hot meals than before the war. Shortage of solid fuel, which was acute until recently, not only increased the consumption of gas for heating, but has caused the housewives to do their washing in the kitchen. Furthermore, the price of gas in Vienna is relatively low, being 2.4 times that of 1937, while the prices of other fuels have risen enormously over those ruling in 1937. Brown coal is 3.6 to 4.2 times as expensive, and coal is 3 to 3.6 times, coke 4.2 times, and wood 5.2 times. It is of interest that the price of gas progressively decreased since the days of the Imperial Continental Gas Association, until it was raised towards the end of the first world war, to be followed by successive increases during the inflationary period after this war. The price was fixed for short period of six and four weeks and finally for weekly periods with payments in advance, in order to avoid the financial collapse of the undertaking. For economic reasons and also for the sake of simplicity, in several districts meter reading, invoicing, and collection was carried out in one operation, a measure now uniformly adopted.

The gas price reached its maximum with 2,040 Krones at the end of the inflationary period, but was reduced during the following two years to 1,900 Krones, corresponding to 19 Groschens after the monetary reform in 1925 (schilling currency).

In 1933 a multiple tariff was introduced, with price differen-

* Patent applied for.

† Schreinzer: Ztsch. Osterr. *Verein von Gas und Wasserfach.* October, 1948. Egerer: *Gas, Wasser, Warme,* September, 1948.

tiations for domestic, heating, and industrial gas, but was again abandoned in 1947, when the price was fixed at 20 Groschens per cu.m. It was raised in August 1947 to 34 Groschens, and in June, 1949, to 50 Groschen as a result of wages and price agreements.

The Vienna Gas Undertaking as an Economic Factor

The importance of the gas undertaking as an economic factor in the life of country and city is best gauged by considering its contributions in rates and taxes, the direct revenues derived from it, and its value in providing free street lighting, as well as playing its part in the reconstructional period. The following table shows the cumulative results between 1899 and 1948, expressed in 'schillings' at their value in 1937:—

(1) Government Taxes		189.6mill. sh.
(2) Communal Charges & Rates:		
(a) Rates and other charges	152.8	
(b) Revenue	209.4	
(c) Public Lighting	152.4 ...	514.6 mill. sh.
(3) Investments		431.9 mill. sh.
	Total	1,136.1 mill. sh.

It is thus clear that the Vienna gas undertaking has not only proved its value as a public utility undertaking, but also as an important economic factor in the life of city and country. The millions of 1899 were not buried, but only put into the ground as seed, which bore ample fruit.

Gas by Air

THE four gas plants in the Western zone of Berlin use approximately 1,000 tons of coal a day. During the Berlin airlift this coal was transported by 'plane. Mr. Virgil Stark (*Gas Age*, July 7, 1949) has just described a project providing for the substitution of part of this coal by propane to be mixed with the manufactured gas. Investigation into the project was made by Mr. Stark and Mr. K. Weil, both of the North American Utility and Construction Corporation and North American Petroleum Gas Corporation, at the request of the U.S. Army. They went on a special mission to Berlin to study the local conditions. It was estimated that for each ton of propane there would be a saving of approximately four tons of coal and after deduction of the tare of propane tanks, the net saving would be approximately three tons. If only 50 tons of propane were used daily, the saving of weight for the airlift would have been 150 tons per day. This would represent a saving of 15 flights daily.

After considerable study the conclusion was arrived at that 1 ton of propane can substitute 4.1 tons of coal, the average for the Berlin plants being 4.35 tons. Different types of pressure tanks for shipping the propane were investigated, and several solutions were studied for the utilisation of propane in the Berlin gas plants. One solution consists in enriching the present low heat value gas of 400 B.Th.U./cu.ft. to one similar to the pre-war level of 515 B.Th.U./cu.ft. Assuming the same heat sendout in the propane consumption for such enriching would have required approximately 1,000 tons/month. The propane vapour in the gas would be only 4.5% of the total volume. The gravity of the final gas would be increased from approximately 0.6 to 0.64.

By making more waster gas and producer gas and using the sets available and now idle, the heat value of the manufactured gas could be reduced to approximately 350 B.Th.U./cu.ft. and the gas enriched with propane to 515 B.Th.U./cu.ft. In this case 1,500 tons of propane would be used per month. The propane would represent 6.75% of the volume and the gravity would be 0.67.

Propane diluted with air could also be mixed with the manufactured gas up to 18% of the sendout volume without changing the combustion characteristics of the gas and without adjustment of appliance. The propane consumption for this purpose would be approximately 900 tons per month.

Therefore, between propane enriching and diluted propane mixing up to 2,400 tons/month could be used in the Berlin gas plants.

Diluted propane could also be used after proper changes for substituting the 230 tons of coke used daily for the underfiring of the ovens. This utilisation would represent up to 2,700 tons of propane per month. The total use of propane would therefore be up to 5,100 tons/month or 170 tons/day.

The maximum saving in coal and coke would be up to 700 tons per day. The saving in the airlift of 500 tons per day or 15,000 tons/month represented 1,500 'plane flights/month and approximately $2,500,000 saving monthly.

The suggestion was made, however, to start with a utilisation of 30 tons of propane per day either for enriching or diluted propane mixing or both. If instead of using the saving of 90 tons per day in airlift weight an additional 90 tons of propane per day were shipped the gas sendout in B.Th.U. could have been increased by approximately 50% using the same airlift 'planes and at the same cost.

The end of the Berlin airlift solved the problems much better. However, for the first time in history, a project to ship propane by air was studied and found feasible and economical.

Work Well Done

IN 1923 a group of chemists interested and engaged in gas and fuel research in the United States of America felt the need of a special organisation in the American Chemical Society in which papers pertaining to subjects in this field could be given and discussed to better advantage than in the other more heterogeneous divisions, such as the Division of Industrial and Engineering Chemistry. Prominent in this group were Professor S. W. Parr, of the University of Illinois, and, at that time, dean of American coal chemists; Professor T. T. Haslem, of the Massachusetts Institute of Technology, where a special course in gas and fuel engineering has recently been established; Russell S. McBride, consulting chemical engineer, of Washington, D.C.; F. W. Spurr, chief chemist of the Koppers Company, Pittsburgh, Pa.; and Arno C. Fieldner, superintendent of the Pittsburg Experiment Station of the Bureau of Mines.

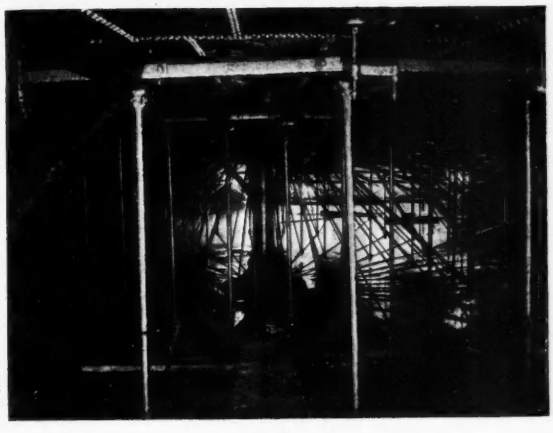
In the *Bulletin of Abstracts* of the American Chemical Society, Mr. Fieldner explains how, in 1923, a request was made to the officials of the American Chemical Society for the establishment of a special group for gas and fuel chemistry. This request was approved, and tentatively the Society authorised the formation of a section of gas and fuel chemistry. The first programme of the section was held at the Milwaukee, Wis., meeting in September of that year. It started with 13 papers of which six were contributed from Professor Parr's laboratory at the University of Illinois, two from the Massachusetts Institute of Technology, two from the Bureau of Mines, and one each from the Koppers Company, the Bureau of Standards, and the University of Michigan. In September, 1925, the name of the Gas and Fuel Section was changed to that of Division of Gas and Fuel Chemistry.

Interesting programmes were presented at most of the national meetings of the Society and in many instances part of the proceedings consisted of meetings with other divisions of the Society, such as the Division of Industrial and Engineering Chemistry and/or the Division of Petroleum Chemistry. In the first 10 years of the existence of this group, the Bureau of Mines, the University of Illinois, and the Massachusetts Institute of Technology led in contributing the largest number of papers; however, many other laboratories made excellent contributions. Since 1930 the leading positions in number of contributions have been held by the Bureau of Mines, the Coal Research Laboratory of the Carnegie Institute of Technology, the Illinois Geological Survey, and the Mineral Industries Experiment Station of Pennsylvania State College. Several outstanding meetings on combustion have been held by the Gas and Fuel Division in co-operation with the Petroleum Division and the Division of Industrial and Engineering Chemistry.

The Proof of the Puddling?

BY THE EDITOR

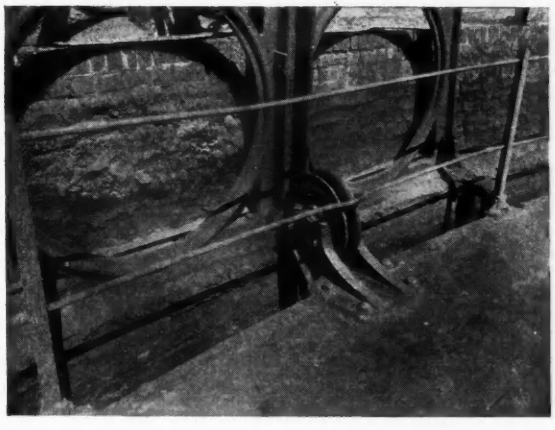
ON page 117 of Vol. 2 of *King's Treatise on Coal Gas*, published in 1879, there appears an engraving showing a single-lift gasholder at the Fulham gasworks. This holder was among the first employed by the Imperial Gas Company. It was erected in the year 1829. In a brief description of this holder it was remarked in *King's Treatise* that for the past 50 years 'it has been in constant action, and so is a remarkable instance of the durability of holders, even when constructed, as formerly, of comparatively thin sheets.' That comment was written 70 years ago. The astonishing fact is that the holder—the oldest working gasholder in the world—is still in daily operation, in excellent condition, being used at the Fulham station of the North Thames Gas Board as a carburetted water gas relief holder. It is supported and guided by tripods; and at the time it was built the support for the 'roof' consisted of a king post and four or five suspension rods. It was quite a daring and adventurous engineering achievement. In those early days the Royal Society advocated 6,000 cu.ft as the maximum capacity for gasholders. In 1923 Sir William Congreve, inspector under the Home Office of Metropolitan gasworks, reported on the results of the Gas Light and Coke Company at its three stations—Peter Street, Brick Lane, and Curtain Road. From this report the Company must have had holders in excess of 6,000 cu.ft. capacity. But Sir William Congreve himself would have recommended a maximum capacity of 20,000 cu.ft. The more astonishing it is, then, that the Fulham 'original' had a capacity of 225,000 cu.ft.



We thought, when we saw this photograph, that the internal structure of the gasholder was somewhat complicated. Mr. Birks, however, assured us that its beauty lay and still lies in its simplicity.

Last week Mr. F. M. Birks, C.B.E., Deputy Chairman of the North Thames Gas Board (at the time of nationalisation Deputy Governor and Managing Director of the Gas Light and Coke Company), invited us to the headquarters of the Board at Church Street, Kensington (how familiar the address!) to see the plans of this oldest working gasholder, photographs of which we reproduce here. As an engineer Mr. Birks was enthusiastic concerning its simplicity of construction and the craftsmanship which he praised as a connoisseur. The holder, he explained, was re-sheeted in 1888. It has not been out of action since then. The sheeting was 13 gauge. We gathered that in 1829, to put it inartistically, 'they knew a thing or two.' Those were the days of iron as it was wrought; and we suggest that the record of the Fulham holder lends virtue to the work of the puddlers of the North of England which resulted in the following metal (1888) as analysed at a much more recent date: Silicon, 0.15%; manganese, 0.041%; sulphur, 0.012%; phosphorus, 0.9%; carbon, 0.03%.

In King's Treatise on Coal Gas *fewer supports were shown in the diagram of the holder, and it was mentioned that the South Metropolitan Gas Company was not slow to follow the example of the Chartered Gas Light.*



A close-up of the roller, which has rolled well and truly for 120 years.

And who built the holder? Early records shows that Messrs. Ward, Junr. and Wright were responsible. We regret that nothing more about these redoubtable pioneers can be traced.

'Rust' was the subject of a half-hour unscripted discussion broadcast from the corrosion laboratory of the British Iron and Steel Research Association at Birmingham last week. The economic importance of the prevention of rust was emphasised and listeners were given a description of the Corrosion Committee's campaign. Dr. Hudson, leader of the laboratory, and Mr. G. P. Acock, a member of the staff, were joined in the discussion by Mr. T. M. Herbert (British Railways), Dr. J. W. Jenkin (Tube Investments, Ltd.), Mr. F. Fancutt (British Railways) and Mr. G. Smith (Alfred Holt & Co., Ltd., Blue Funnel Line).

DEVELOPMENT OF THE HIGH PRESSURE DISTRIBUTION SYSTEM IN DUNDEE

By W. S. JOHNSTON,

Engineer and Manager, Dundee Gas Undertaking

***EDITOR'S NOTE*:—The author reviews the development of the high pressure distribution system at Dundee with the intention of providing a guide for those who may be contemplating either the installation or the extension of high pressure supplies. The paper describes both the physical difficulties and the technical problems encountered locally, and the author believes that 'as a warning as to what should not be done' it may be of assistance in the development of those schemes which the impending regionalisation and centralisation of the industry will require.**

IT was with some diffidence that I accepted the invitation from our President to present a paper to the North British Association. First, I am a comparative newcomer to the ranks of the Association, and secondly, I had some information as to who was to be my co-partner at this session. The subject was one to which I gave much thought, but at last I decided that the development of high pressure distribution in Dundee was one which, in present circumstances, might be of some interest.

Dundee Geographically

Before describing the growth of the high pressure distribution system, I should like to give you some idea of the physical aspect of Dundee.

If you will examine the map inserted with the paper, you will see that the dominant feature of the landscape is the Law Hill. Old Dundee lay entirely on the south side of the hill which is situated on the southern edge of a plateau some 380 ft. above sea level. The steepest drop from the hill is that at right-angles to the shore line of the Tay Estuary. North of the Law Hill there is a plateau which, after running practically level, rises gradually to the north, while to the north-west Gallows Hill rises. To the north-east and east of the hill there is a valley through which flowed the Den Burn, the far slope of the valley ending in a ridge which juts out from the plateau and runs almost due east, gradually descending until it loses its identity in a coastal plain which slopes gently down to the Tay Estuary. Clepington Road runs along this ridge and continues as East Kingsway—the Dundee By-pass Road—the east end of which coincides with the end of the ridge.

West of the Law Hill a valley runs in a north-westerly direction towards the suburb of Lochee, and the west side of the valley is formed by the twin hills of Balgay. The stream which flowed through this valley was called the Scouring Burn—so named because its waters were used in earlier days by the citizens of Dundee for the weekly wash. North of the Clepington Road-Kingsway ridge, the ground falls away to the valley of the Gelly and Dichty Burns. Downfield, once a separate community and now a suburb of the city, is built across the Gelly Burn valley and on the high ground dividing the two streams.

The gasworks originally lay to the east of the town, but is now situated not far from the centre on an east and west line. It still, of course, lies on the southern edge of the city on a north and south line. The steep hills and the valleys to the north of the Clepington Road ridge have caused the main headache in distribution for many years now.

Both the Den and Scouring Burns have disappeared from sight, their waters being now piped down to the Tay, but the valleys are there and have been utilised as routes for the low pressure gas supply. The Den Burn valley also forms the main route of the high pressure system.

Mr. Johnston was educated at Dundee High School and Dundee University College, where he graduated B.Sc. (Eng.). Joining the Dundee Gas Department in 1924, he went to the drawing office in 1926 and was appointed first technical assistant in 1933. He became Assistant Engineer in June, 1946, and was appointed Engineer and Manager in 1947. He is now Group Manager of the Dundee group.

The Gelly Burn and Dichty Burn valleys have not so far been used, as until recently the streams formed, over part of their course, the boundary line of the city. Recently, however, with the extension of the city northwards, these streams are within the boundary, and development has already taken place to the north on the east side of Forfar Road. Proposals are being formulated whereby the valleys of the Gelly and Dichty Burns will be utilised as a route for a new low pressure supply, which, starting at the gasworks and travelling initially eastwards before turning north and west, will avoid the rapid rise and fall necessary in crossing the Clepington Road—Kingsway ridge further west. The crossing point will practically coincide with the disappearance of the ridge and the route of the main will be in close proximity to the more recent and future developments both in housing and industry.

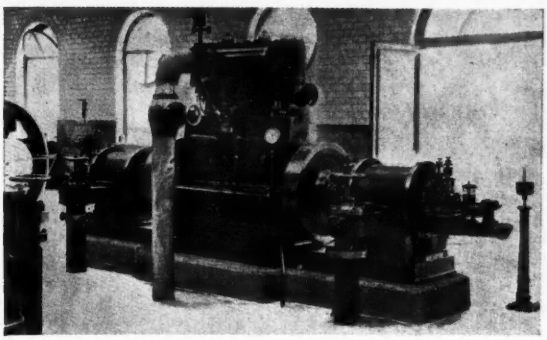
First High Pressure Main

The first H.P. main was laid in 1910, and was installed to augment the L.P. supplies to areas in which these supplies had become inadequate. It consisted of a 6 in. dia. steel main laid from the works to a point near the place where the Clepington Road ridge meets the plateau north-east of the Law Hill. The route was somewhat circuitous. En route a 4 in. dia. branch was taken off to a 4 in. H.P. Reynolds governor set in a pit in McDonald Street (Governor No. 1) which lies about half way up the slope of the hill from the river to the plateau. The work was completed as far as the junction of Hospital Street and Strathmore Avenue. The following year the main was continued as two 4 in. dia. mains, the first going westwards to the west end of Loons Road, where a second 4 in. governor was installed underground (Governor No. 2). This main was then continued to Perrie Street, Lochee, where a holder had previously existed and a 4 in. governor was installed in the old station (Governor No. 3). The second 4 in. main was laid in a northerly direc-

tion to a 4 in. governor installed in Gillburn Road, Downfield (Governor No. 4).

Compressor No. 1

The first compressor, installed at this time, was built by the Bryan Donkin Co., Ltd., and was of the rotary type, consisting of two drums driven by a vertical steam engine. Its capacity was 30,000 cu.ft. of gas per hour at an output pressure of



Compressor No. 1 installed in 1910.

10 lb./sq.in. This compressor was installed in the exhauster house.

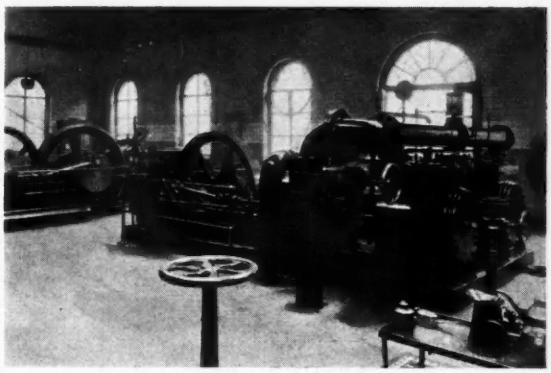
Amalgamation of Broughty Ferry

The year 1913 saw the amalgamation of the Burgh of Broughty Ferry with the City of Dundee, and in 1914 an 8 in. high pressure main over 6,000 yd. long was laid from the Dundee gasworks to Broughty Ferry gasworks, and a second compressor was installed in the exhauster house to pump the gas through this main to Broughty Ferry where an 8 in. Reynolds governor (No. 5) was built to serve the community. The existing gasholders were used for the night supply and were filled night and morning as required from the high pressure main. This practice still continues with only one holder of 160,000 cu.ft. capacity, the other two smaller holders having been now demolished. The compressors work from 6.30 a.m. to 11.30 p.m. on weekdays and from 7.30 a.m. to 10.30 p.m. on Sundays.

The compressor (No. 2) was built by George Waller & Son, Ltd., and was in reality a duplex set of double acting reciprocating compressors delivering 40,000 cu.ft. of gas at 5 lb. pressure. This main was entirely separate from the original 6 in. main. Prior to the amalgamation with Dundee the street lighting system was operated on the pressure wave system by means of an electrically-driven booster. Some years before the war, the booster was put out of action and the pressure wave was operated by overloading the mercurial governor on the outlet of the Reynolds district governor. It was decided to retain this system of lighting and the low pressure distribution systems in the city and the suburb have remained separate, although during the 1939-45 war, when street lighting was out of action, the mains at the east end of the Dundee system and the west end of the Broughty Ferry system were linked up and valved. In times of shortage of stock it was possible to maintain a supply through these mains at night without recourse to the holder at the Broughty Station. The reintroduction of street lighting necessitated the closing of these valves, and Broughty Ferry is entirely dependent on the one high pressure main and the stock in one holder.

Governor Replacements

Soon after the 1914-18 war, much trouble was experienced with burst diaphragms in the governors, and those in the pits in McDonald Street and Loons Road were particularly nasty to repair. Steps were taken to procure land near the governor sites, and governor houses were built in which were installed new 8 in. Reynolds governors in duplicate. The year 1920 had seen, as a preliminary to the installation of these larger governors, the replacement of the original Bryan Donkin



Compressor No. 3 installed 1920. No. 2 Compressor in background.

compressor by a 100,000 cu.ft. per hour Waller double-acting tandem horizontal compressor (No. 3) working at 10 lb. per sq.in. pressure. I cannot understand why a double-acting engine was built here, as the inlet steam pressure was 100 lb./sq.in. and the low pressure cylinder exhausted to atmosphere. This compressor was built on the site of the original Bryan Donkin machine. The new governors were in operation in 1924.

New Housing Developments

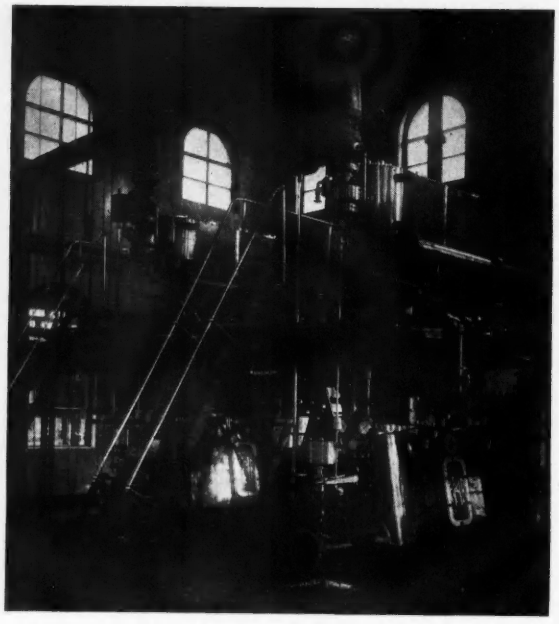
The housing development in Dundee in the latter part of the 1920-30 decade took place mostly in areas not far from the routes of the high pressure mains, and it was decided to extend this system rather than the low pressure system. This latter extension would have involved laying large mains through narrow streets already carrying as much underground plant as they comfortably could.

Baxter Park Governor

Lack of pressure in the Baxter Park area was overcome by laying a branch 4 in. high pressure main from the existing 6 in. main in Ferry Road and installing in a governor house in Baxter Park Terrace 4 in. Bryan Donkin Reynolds governors in duplicate (No. 6). With the alteration of the route of the H.P. main in 1928-31, which will be described later, this 4 in. main was connected to the 8 in. Broughty Ferry main. A rather unfortunate feature of this arrangement is that in summer when the extinguishing times for street lamps occurred prior to 6.30 a.m. it is necessary to start up a compressor in order to give a wave for this purpose. The starting-up of the compressor, of course, brought the Baxter Park governor into operation at 5 in. W.G. pressure. Since the main L.P. governor pressure during the night is 3 in. W.G. the effect of this pressure rise was considerable, and had quite an effect on the operation of the main works governors. This year, however, the Baxter Park governor main has been disconnected from the B.F. Main and connected into the 9 in. H.P. Dundee Main.

In 1928 contracts were placed for the supply of 9 in. dia. steel long sleeve joint pipes to be laid to replace the original 6 in. main running from the works to Lochee governor station. At the same time, two Fullerton Hodgart & Barclay compressors (Nos. 4 & 5), each capable of delivering 200,000 cu.ft. per hour against a 20 lb./sq. in. pressure, were ordered. Plans

were prepared for a new compressor house about 30 yards south-west of the exhauster house and adjacent to the main



Fullerton, Hodgart & Barclay Compressors installed 1930.

boilers. The compressor house was built by works labour. Work commenced on the laying of the new 9 in. main in June, 1928. A study of the plan will show that the route followed was slightly different from and more direct than that of the original 6 in. main, greater use being made of the natural Den Burn Valley than in the original route. During this year the main was laid as far as Laing Street (marked 'A' on the plan) and was connected at that point to the existing 6 in. main. The work was continued in May, 1929, and by November of that year the new main had reached point 'B' on the plan. In 1931 the last stage of the journey to Lochee governor station was completed.

New Compressors

The building of the compressor house and the installation of the new compressors had been completed in 1930, and these had been working although the new main was not complete. The Broughty Ferry main had been diverted inside the works to receive its supply from the new compressors and the two compressors in the exhauster house dismantled and sold to Worcester Gas Company.

The new Fullerton Hodgart and Barclay compressors were twin-cylinder vertical tandem steam driven compressors with the steam cylinders above the gas cylinders. The cranks were at 180°, which was a bad feature, as at off-peak periods the engines would not start unaided if by any chance the demand for gas was not sufficient to keep them running constantly. Messrs. Fullerton Hodgart & Barclay were air compressor makers, and the compressors in Dundee were the first gas compressors this firm had built. They worked on the same principle as the more common portable air compressor, where a receiver is pumped up to a set pressure and the engine cuts out and idles until the pressure drops in the receiver sufficiently to require replenishing. As the only receiver on the high pressure main was a comparatively small anti-pulsation tank the compressors were continually revving-up and cutting out, and to gas men who were used to machines like exhausters running at gently fluctuating speeds they were rather alarming to listen to. However, the problem of pressure control was eventually solved with the help of the Bryan Donkin Co., by the installation of one of their relay pressure controllers.

Craigiebank Housing Scheme

About 1928 Craigiebank housing scheme, a large scheme not far from the works to the north-east, was nearing completion, and the staff at the works were alarmed at a lack of supply during peak periods. There is only one 12 in. low pressure main running eastwards from the works in Dock Street, and this main disappears very quickly as a trunk main in the region of Market Street. At that time Dock Street was a cul-de-sac at its east end, and the narrowness of the Ferry Road made the laying of a new main in this direction a nasty proposition.

It was therefore decided to tap the 8 in. main to Broughty Ferry which passed on the south side of the road to the south of the housing scheme. A 4 in. main was therefore laid across the road about the middle of the scheme from the high pressure main and connected to the low pressure system through a 4 in. Bryan Donkin pressure regulator (No.7). Since then the supply of gas to this scheme has been satisfactory.

This governor is still affected by the operation of the compressor for early morning extinguishing of the street lamps in Broughty Ferry, and this cannot be obviated until a new low pressure main is laid from the works through the housing scheme. Plans for such a main are now in hand to meet a large future increase in consumption to the north and north-east of the city.

Further Extensions to the H.P. Main

During 1929-31 when the new 9 in. main was being laid, new housing schemes were being built to the north of the route in Arklay Street and Caird Avenue. In 1929 a 4 in. branch was run up Arklay Street to Dundonald Street where an underground 4 in. pressure regulator (No. 8) was installed. In 1930 a 4 in. branch was taken off the 9 in. main at Caird Avenue and another 4 in. regulator (No. 9) was laid in the footway of Caird Avenue. 1933 saw the extension of the 9 in. H.P. main from Lochee holder station to Blackness and Ninewells where 6 in. Bryan Donkin regulators in duplicate were installed in Old Glamis Road (No. 10) and Perth Road (No. 11). The latter regulator feeds the main supplying the village of Invergowrie, the furthest west point of the Dundee supply.

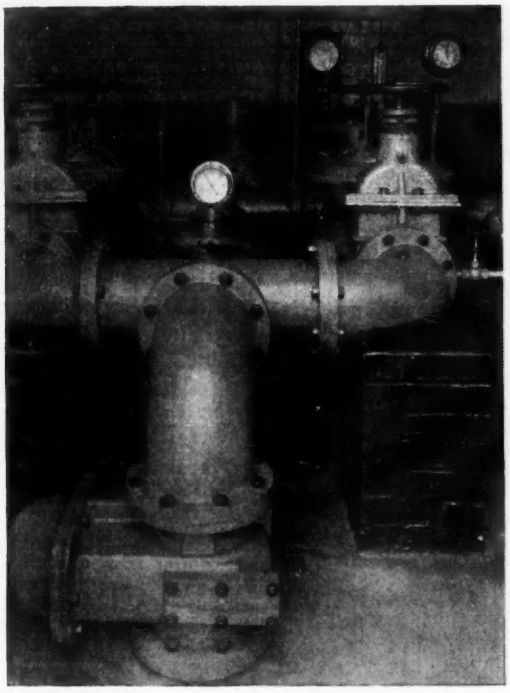
At the same time as this extension was being completed a new 6 in. connection was laid from Milton Street to MacDonald Street governor (No. 1) by a slightly different route to enable a governor to be installed at Stirling Park housing scheme. The work of connecting these new extensions to the 9 in. main was carried out at one time, together with connections to the original 4 in. mains feeding the governors at High Street, Lochee (No. 2) and Downfield (No. 4), which up to this time had been fed via. the original 6 in. main. The 4 in. main feeding governor No. 1 which was badly pitted in parts was then cut off at points C and D. The only governor remaining on the original 6 in. main was a small 2 in. governor, of the installation of which there is no record. The disconnection of this remaining part of the 6 in. main was carried out last year, as, through corrosion, the main was a continual source of trouble.

Mercurial Safety Governors

It was about this time that Peebles mercurial governors were placed at the outlets of the twin Reynolds governors as a safety precaution against the failure of the latter. The mercurials were set for a slightly higher outlet pressure than the Reynolds governors and normally remained full open. Should a breakdown of the Reynolds governors cause the H.P. main pressure to pass direct to the mercurial, the latter came into operation and prevented a surge in the L.P. mains.

Later installations saw a system of twin sets of Peebles dia-

phragm and mercurial governors arranged in tandem with both governors set to district pressure. Still later practice, which has been adopted in most governor stations, is to use



Reynold's Governors in duplicate with Mercurial Governor at outlet.

the diaphragm governor as a differential governor and the mercurial as a final pressure governor. This ensures that both governors are normally in operation and still retains the safety element in the mercurial governor.

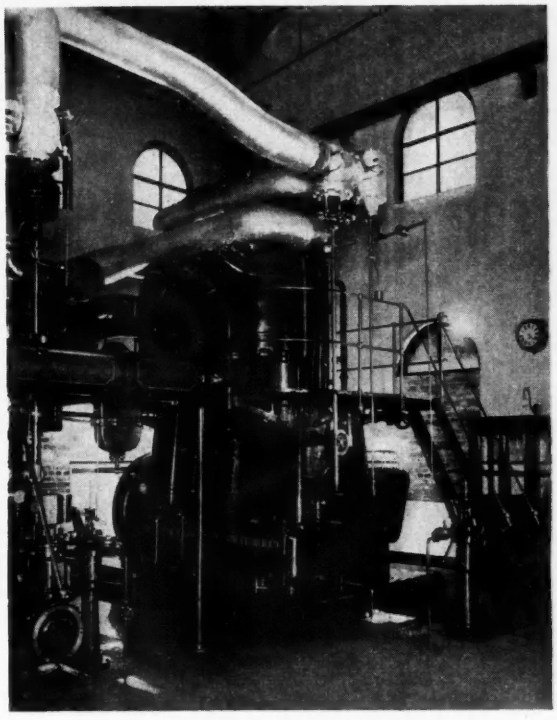
Extensions in Broughty Ferry

Private house building in Barnhill, the easterly end of Broughty Ferry, caused deficient supplies of gas in this area, and it was decided to extend the 8 in. main feeding into Broughty Ferry holder station to the end of the Esplanade at Bridge Street. Duplicate 8 in. Peebles diaphragm and mercurial governors in tandem (No. 12) were installed on the south side of the railway and connected into the L.P. mains in Bridge Street. This work was completed in 1934, and a satisfactory service has been maintained in the area since then.

Extensions North of Clepington Road Ridge

In 1935 further housing extensions to the north necessitated increased supplies in the Kingsway region. After borings had been made, a 6 in. branch was taken from the 9 in. main at the foot of Arklay Street, and a main was laid northwards to Kingsway. En route the No. 7 governor was connected to the new main and a duplicate 4 in. peebles diaphragm and mercurial governor (No. 13) was installed at the Graham Street-Kingsway junction. The main was then run eastwards along Kingsway to Mid Craigie housing scheme, where a similar governor (No. 14) arrangement was set up. Later another 6 in. branch was laid westwards from Graham Street to Strathmartine Road, where another 4 in. governor (No. 15) was installed to augment the supply to Downfield which was being inadequately served by the original governor (No. 4).

The year 1936 saw the installation of the latest compressor in the compressor house. This machine is a twin cylinder tandem steam driven compressor having a capacity of 300,000 cu.ft. of gas at 300 revs. against a pressure of 20 lb./sq. in. The steam cylinders are above the gas cylinders, and the cranks are at 90°. This setting obviates the trouble found with compressors Nos. 4 & 5—*i.e.*, difficulty in re-starting if the compressor engine stopped at times of low consumption.



Bryan Donkin Compressor installed 1936.

This compressor starts automatically when the gas pressure falls in the outlet main. Certain modifications to the outlet piping were made during the war to allow one of the Fullerton Hodgart and Barclay compressors to run independently on the Broughty Ferry main. This has proved useful at times of peak demand during the winter months.

New Inlet Main

The original inlet main to the compressors was one of 14 in. dia. laid underground from the 30 in. dia. main which is the principal supply main from the holders to the station governors. The draw on this main was such that at times of peak demand the pressure at the inlet to the compressors was dangerously near zero. In 1947 a new 24 in. inlet main was run overhead from a branch from the 30 in. main to the compressor inlet main. The arrangement is such that the compressors can, when necessary, draw gas from one holder while the station governors receive their supply from another. This has improved the working of the boosters at the inlet to the station governors by allowing them to be fed with gas at holder pressure instead of something less due to the suction of the compressors. A further refinement on this new suction main was the by-passing of the main valve by a 2 in. pipe and governor. The governor is set to 2 in. W.G. pressure. When the compressors are shut down at 11.30 p.m. a non-return valve on the by-pass between the compressor inlet and outlet mains opens and allows low pressure gas to flow into the H.P. main. This is necessary in Dundee because of the sudden rise on the main immediately on leaving the works. The governors, being weight loaded, fall full open on shutting down, and if the main suction valve was open holder pressure

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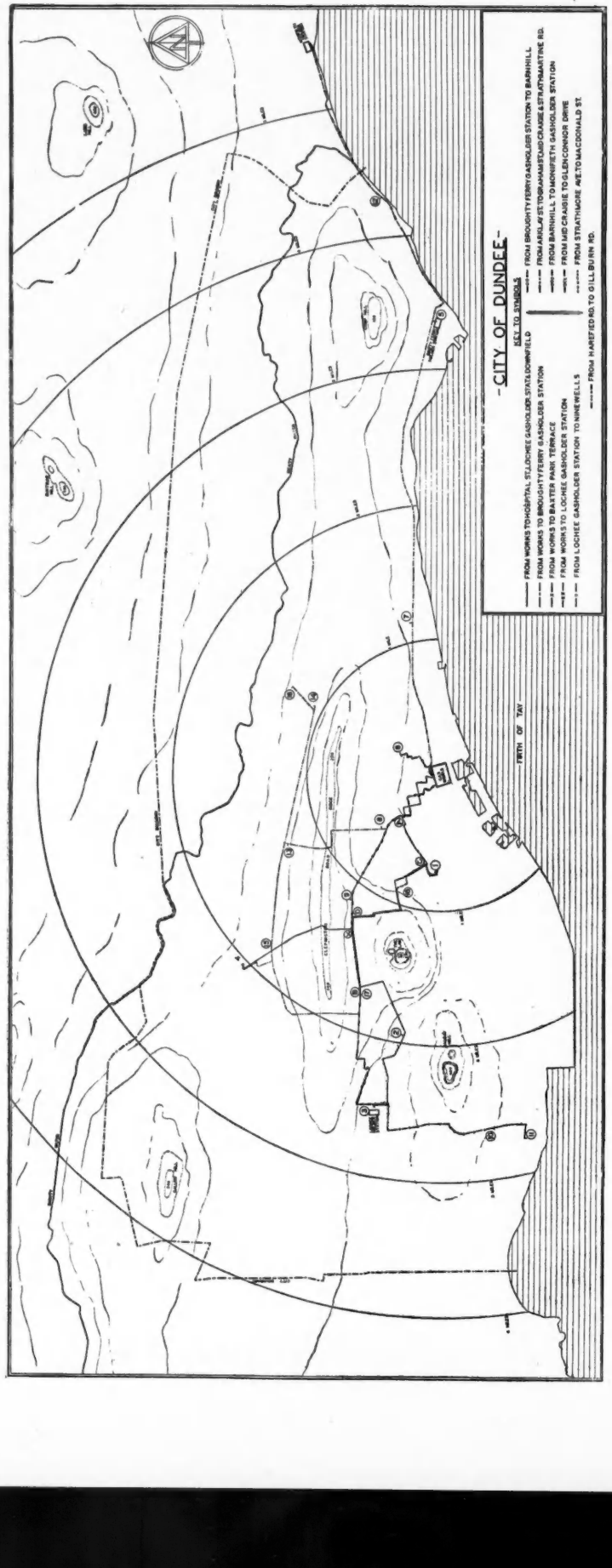
-CITY OF DUNDEE-
KEY TO SYMBOLS
FROM WORKS TO HOSPITAL ST. & LOCHEE GASHOLDER STATION TO DOWNFIELD
FROM WORKS TO BROUGHTY FERRY GASHOLDER STATION
FROM WORKS TO BAXTER PARK TERRACE
FROM WORKS TO LOCHEE GASHOLDER STATION
FROM LOCHEE GASHOLDER STATION TO NINEWELLS
FROM BROUGHTY FERRY GASHOLDER STATION TO BARNHILL
FROM ARBROATH STATION & STRATHMARTINE RD.
FROM BARNHILL TO MONIFIETH GASHOLDER STATION
FROM MID CRAIGIE TO GLENCONNOR DRIVE
FROM STRATHMORE AVE. TO MACDONALD ST.
FROM HAREFIELD RD. TO GILLBURN RD.
FIRTH OF TAY

would be maintained in the H.P. main and pass through into the L.P. main at the governors. Should the main suction valve be shut entirely the suction main and the H.P. main beyond the compressors becomes denuded of gas, with rather disturbing consequences to the station governors when the valve is opened in the morning. The 2 in. by-pass pipe with its governor allows sufficient gas to be present in the H.P. main to eliminate the disturbance at the station governors.

Additional Governors

Two additional governors were installed in 1937. The first in Carmichael Street (No. 16) to serve Stirling Park housing scheme: the H.P. main to MacDonald Street governor (No. 1) had been diverted for this purpose in 1931. The second was installed in Harefield Road (No. 17) to feed a large new slum clearance scheme to the north.

Linlathen Housing Scheme

In 1938 Linlathen housing scheme came into the picture. This scheme, which consists of cedar timber houses, lies north of Kingsway and west of Pitkerro Road where the ground falls rapidly towards the Dichty Burn. The scheme was completed just when war was declared in 1939. The gas supply was found to be inadequate and steps had been taken to install a 6 in. Peebles diaphragm and mercurial governor set well down the hill at Glenconner Drive. However, the war intervened and the work was held up. The occupants of the houses suffered very patiently from deficient supply and immediately after the war the 6 in. H.P. main was extended from Kingsway to the proposed site of the governor and the governors (No. 18) were installed. The work was completed just before New Year, 1946, and the governors actually put into operation on that most important day of the year to Scots gas engineers—Hogmanay. The additional load on the 6 in. main from Dens Road, however, showed a defect in the system. The 9 in. main on leaving the works generally in a northern direction rises very rapidly until it turns west in Arthurstone Terrace, where a slight fall in the main continues until the main turns north again in Dens Road. At this point a deep syphon had been inserted in the main. In the earlier days of this main little condensate had been found here, and it was felt that initial condensation in the H.P. main was being trapped in the antipulsation tank or running back there from the first rising part of the main. About the end of the war, however, it was found that a considerable amount of condensate was being pumped out of this syphon daily, the pumping usually taking place during the forenoon. It was assumed that as the volume of gas passing along the main increased, the condensate was being carried along past the point where it flowed back to the works. and was flowing in increasing quantities forward to the syphon in Dens Road. What was not realised was that the syphon was

overfilling in the space of 24 hours, and partial flooding of the main was taking place at this point by 6.30 a.m. each morning. The rise in the 9 in. main in Dens Road is gradual until the 6 in. branch at Arklay Street is reached. The branch crosses Dens Road and then rises rapidly up Arklay Street.

When the new No. 18 governor was installed, there was at peak periods no apparent increased supply. Pressure tests on the 6 in. main revealed rapid fluctuations of pressure near the foot of Arklay Street, indicating the presence of water in the main. There was no indication of such in the 9 in. main in Dens Road. There was no sag in the 6 in. pipe between the branch in Dens Road and Arklay Street. The syphon was pumped at various times during the day, but except for the morning pumping when the fill of the syphon was pumped out, there was not an excessive accumulation of condensate. The constancy of the amount of condensate each morning gave rise to the theory that the syphon might be overfilling during the night, and a certain amount of water might be swept up the 9 in. main and become lodged in the 6 in. branch at the foot of Arklay Street, and the sudden rapid rise in the main cause a partial blockage at this point. Orders were given to have the syphon pumped half an hour before the compressor was put into operation for the day. The amount of condensate collected was definitely more than the capacity of the syphon. An adequate supply of gas was then found at Linlathen. To obviate the necessity of early morning pumping, a 9 in. branch was taken from the main at the point in Dens Road where the main turns north from Arthurstone Terrace (point E) and the main extended down Dens Road for a number of yards, the pipe being offset downwards the diameter of the pipe and the syphon was placed at the end of this extension. The syphon and lower part of the pipe are capable of holding between them about 300 gal. of condensate. This work was completed early in 1946 and has completely cleared the branch main of condensate trouble.

Monifieth Bulk Supply

In 1946, Monifieth Town Council approached Dundee Corporation with a request for a bulk supply of gas. After some negotiation an agreement was reached and the work of extending the H.P. main was put in hand. The main is an 8 in. extension of the existing H.P. main to Barnhill laid in 1934. The distance from Barnhill to Monifieth gasworks is just under 1½ miles. Alternative methods of control were considered, but after toying with the idea of a low pressure supply from Barnhill, it was decided to give a high pressure supply through a volumetric governor, and a B. & M. meter into Monifieth holder. The holder capacity is 75,000 cu.ft. In September last year, the work commenced, laying the 8 in. main along the foreshore between Barnhill and Monifieth, and was completed in four weeks, a section of steel main crossing the Dichty water, which at this point runs into the Tay Estuary, having been previously placed in position. The steel section, which was welded in situ, is supported on the abutments and centre pier of the railway bridge crossing the stream at this point also. After completion the pipe section was boxed in with two channels and a plate bottom, the box thus formed then being filled with pitch. Duplicate 4 in. volumetric governors are installed with a Hansen clock control device for shutting off the governor one hour before the compressors shut down, and opening up one hour after they start. The Hansen control was chosen because of the flexibility of its operation. Alterations to closing and opening times can be carried out by alterations to the seven day cams without otherwise disturbing the mechanism. A safety cut-off device is also fitted to the impulse, piping to close the governor automatically when the holder is full and open it when the holder has fallen again. The volumetric governor consists of a diaphragm operated weight loaded governor and an orifice plate in a straight pipe on the downstream side of the governor. Impulse piping is carried from the upstream side of the orifice to the underside of the governor diaphragm, and from the downstream side through the Hansen control and the holder cut-off valve to the upper side of the diaphragm. The pressure loss across the orifice plate is proportional to the volume of gas passing through. The governor is loaded to maintain a constant pressure loss across the orifice and so maintains a flow through the orifice proportional to the pressure loss. Variations in pressure either on the upstream or downstream side of the orifice plate are carried to the governor via the impulse piping and cause it to open or close as required to maintain the necessary equilibrium. Variation of the main governor loading will, of course, cause a variation in the volume of gas passing. After some initial teething troubles, the governor is working very satisfactorily.

Main Renewal

The original 4 in. branch main from Strathmore Avenue to Downfield has been in use until now, but for the past year or so has shown signs of deterioration. It was decided to renew this part of the main, but instead of relaying the new main along the route of the old one, a new route was chosen. This new main is branched from the 9 in. main at a point in Harefield Road about half a mile west of the original main and passes north and then east in Kingsway to link up with both the Kingsway and Downfield governors. This route is slightly longer than the former route but was thought to be more satisfactory for the following reasons:—

(1) The route is much more level than previously, there being practically no rise and fall as in the original

(2) The roads were more recently made and it was possible to lay the main practically all the way in the footway, and tramway routes were avoided.

(3) The main passes immediately to the east of the industrial estate and is closer to the new housing development. It can therefore be utilised for the installation of new governors, or, better still, for a holder station which might be built in this area.

Lochee Holder Station

In 1933 a 3-lift spirally guided gasholder of 1 mill. cu.ft. capacity was built at Lochee gasholder station. The actual site of the holder is south of that of the original holder whose tank rim can still be seen within the station. A branch of the 9 in. H.P. main was connected to the 18 in. holder inlet and until this year the only means of filling the holder was by opening a hand controlled valve and allowing gas to flow. This, of course, was only possible at off-peak periods, and, even so, great care had to be taken that the filling rate was not allowed to interfere with the working of other district governors, especially Nos. 9 & 10 at Blackness and Ninewells. It was usually only possible to allow 300,000 cu.ft. of gas into the holder between 8.30 a.m. and 10.30 a.m. and between 2 p.m. and 4 p.m.

The 18 in. outlet main was connected to a 10 in. trunk main through an 18 in. Peebles self loading governor. The reduction to 10 in. took place immediately on the outlet of the station governor. This greatly restricted the amount of gas which the holder could deliver. The high pressure governor was kept in operation and the loading of the holder governor was such that the holder only operated when the demand caused the high pressure supply to fail to maintain the district governor outlet pressure at 5 in W.G.

In 1945 a new 10 in. low pressure main was laid running northwards towards new housing areas and the new industrial estate. There were now two 10 in. mains being fed from the holder and from the district governor. It was felt that as long as the holder was being used as a standby and feeding only at peak periods at 5 in. W.G. the self loading station governor was not the correct type of governor for the station. Another fault of its loading system was that when the H.P. supply was shut at 11.30 p.m. the station governor came into action to supply gas at 5 in. W.G., which was too high for the night time load.

The self-loading part of the governor was therefore removed and the differential part was converted to a main governor with

a Peebles clock controlled loading relay governor installed to vary the pressures to suit existing conditions and requirements. These were to retatin the holder as a standby but to force it into use at peak loads by increasing the district pressure to just over 5 in. and definitely give the holder some work to do then and save the high pressure supply for other district governors. At other times the holder pressure was reduced so that it would only come into operation if the high pressure supply failed.

It was realised that, with the development of the industrial and housing estates in this area, the load on the H.P. main was about to become excessive at peak periods and that something would have to be done to meet the growing demand.

Plans were therefore put in hand to install at Lochee holder station a twin set of 6 in. volumetric governors capable, with a restricted orifice, of supplying 500,000 cu.ft. of gas into the holder daily during normal hours of high pressure supply. This supply can be more than doubled by increasing the orifice on the governor.

It is also proposed to lay an 18 in. low pressure main from the holder station to skirt the south side of the industrial estate and increase the supply to the plateaus area north of the Law Hill and to the north eastwards as far as the Clepington Road ridge.

Such a system with the Lochee holder in operation 24 hours of the day with its clock controlled station governor set to given the necessary variations in pressure for satisfactory supply will give considerable relief to the works compressors at peak load. The benefit of this will be realised when it can be stated that three district governors and one regulator will be dispensed with when the scheme is completed.

A similar scheme to that for Lochee holder station is being worked out for Broughty Ferry, where it is hoped to build a new holder of 1 mill. cu.ft. capacity to feed the Broughty Ferry area and that part of Dundee immediately to the north which will develop in the next few years as both a housing and an industrial area.

Conclusion

In presenting this paper, I have attempted to put on record the story of the high pressure supply system in Dundee. It has grown until during the winter months 35% of the gas supply is pumped through the compressors and over the peak hour at mid-day 40% of the gas supplied is high pressure supply. In my opinion, prime moving machinery working at maximum capacity should not be asked to carry such a proportion of the peak load. Much rather would I see the high pressure mains used to fill district gasholders at a fairly constant rate through volumetric governors or by some means of remote control, and let the holders take the load fluctuations. The Bryan Donkin compressor is capable of an output of 300,000 cu.ft. of gas per hour and has to work to this capacity over the peak period. The daily output during the winter months on the high pressure mains is in the region of 3 mill. cu.ft., the compressors working from 6.30 a.m. till 11.30 p.m.—*i.e.*, 17 hours out of 24. The new method of feeding into and supplying from Lochee holder will allow four H.P. governors —Nos. 2, 3, 9, and 17—to be put out of action. Were it possible to replace all the district governors by suitably sited gasholders, as the four already mentioned will be replaced, the Bryan Donkin compressor, working at a rate of say 200,000 cu.ft. per hour (well within its capacity) over 24 hours, could supply nearly 5 mill. cu.ft. of gas daily into these holders.

As it might not be possible to replace all district governors by even the best siting of gasholders, a few of the former may have to remain, but by clock controlling their outlet pressures some improvement in district pressures would follow and the filling of holders could be restricted to off-peak and night periods. An argument might be made against the cost of gas holders compared with costs of compressors and district governors, but so far as Dundee is concerned the present holder capacity is 1,500,000 cu.ft. below that considered adequate. The works area is restricted for future gasholder development, and I consider that district gasholders are the answer to the problem of future development in the works. It is proposed to adopt a system of remote indication of stock, pressures, &c., from the holder stations with a view to a later adaptation to remote control when the number of district stations warrants such a scheme.

Finally, I wish to thank our President for honouring me by inviting me to present this paper to the N.B., and hope that I have not disappointed him or you. I would also like to acknowledge the assistance given by my staff in Dundee in digging into past records for the bones round which the paper was built. I trust they have been adequately covered.

DISCUSSION

Mr. **W. C. Campbell** (Galashiels) said that as manager of a small undertaking having facilities to supply other areas he had studied the paper and gained in knowledge. In planning their own scheme they had overlooked some wise suggestions made by Mr. Johnston.

Mr. **F. R. Mitchell** (Lanarkshire Group) said that the account of the topography of Dundee was interesting, but present-day costs of mains and mainlaying did not allow any latitude in the choice of routes, and generally they must find the most practicable direct route compatible with the purpose of the system. In Dundee there were two principal systems, one having to a large extent replaced an original main. The paper emphasised what so often occurred in high pressure work—that the ultimate uses far exceeded the originally designed purpose. The choice was limited when planning from an existing high pressure system, and too often a form of subsidiary and arterial systems developed from the feeder main to the detriment of the purpose for which the main was originally provided. Where new high pressure systems were under consideration, long term policy could be determined and a measure of provision made for future building development by consultation with the town planning and housing authorities. He had not the same confidence where industry or industrial estates were concerned.

In the planning of the distribution system for the new town of East Kilbride, consideration was being given to the division of the area into supply units, each controlled by pressure regulator, and to the use of trunk mains operating at above normal supply pressure. The scheme was still in the preliminary stage and technical considerations might later require modification of the principles adopted. This principle could readily be applied to many high pressure systems.

He had hoped Mr. Johnston would offer an opinion on the most suitable pipe and joint construction for high pressure work, but perhaps the general use of spun iron pipe and mechanical joints for this work required no further comment. It could be appreciated that at Dundee the experience of compressing plant was fairly wide, but he thought that the compressing plant development might with advantage have followed another plan. In future they might expect to hear more of compression from a central source with possibly a number of independent feeder mains from the supply point, on 24-hour operation and at various outputs from minimum during the night (except when supplying to district holders) to the various pressure stages during the day. Compressing plant might be in appropriate unit capacity relative to the total high pressure output. In principle, rather than one large compressor of capacity equal to maximum requirements, which often meant exceptional conditions experienced infrequently, compression conditions might be met by the use of a smaller plant for average and minimum output duties and the starting up of medium-sized compressing plant for peak and exceptional loading. Local conditions would, no doubt, dictate some variation in this principle, but the use of a single unit operating much below rated capacity was uneconomical and inefficient. He had hoped the author would have had something to say of operational costs of high pressure distribution, and possibly given a lead upon prime movers in compressing plant. High pressure distribution of any magnitude often created conditions of abnormal steam consumption, and for that and no other reason, electrical drives would probably be increasingly used. Some undertakings avoided abnormal steam demand during peak period and provided a safeguard against breakdown by the joint use of steam and electrical power. The use of unit compressors lent itself to this practice.

Regarding the use of diaphragm-cum-mercury governors

for district pressure control the merit of use was in the safety provided, but this could be only for a limited pressure range. Would the author give some further information upon the efficiency of these governors in normal working and upon the conditions experienced if at any time the mercury governor was the direct controlling unit? Mr. Johnston had mentioned the effect upon district governor of starting up the compressor for the operation of the public lighting pressure-wave at Broughty Ferry. Might this be overcome by the use of a small electrically driven booster at the Ferry distribution station? There was one governor to which he would direct the author's particular attention—the one used for augmenting the gas supplies to Stirling Park housing scheme. He was glad to learn that additional gas supplies were required in this scheme where district heating had been so much publicised.

Regarding district holders, the siting of gasholders as an integral part of the supply system was now general practice; and outside the question of available building ground at the manufacturing works, additional storage for an undertaking could with many advantages be placed on the district. The Lochee holder appeared to be mainly used as a standby. With present-day costs they could not afford such expensive standby equipment. There were instances where increasing demand had been met by a complete scheme of medium or low pressure feeder mains and the erection of a district holder, when the project could, with reasonable safety and adequate supplies, have been executed in development phasing by carrying the area for a period on the feeder main until the further expansion of gas demand necessitated the second stage of the project—the erection of the holder.

The undertaking which he (the speaker) served was an integrated undertaking and comprised nine undertakings which were orginially operating as independent units. About 73% of the total output was transmitted under high pressure of about 8 to 9 lb. per sq. in. during peak periods. Manufacture was centralised in two works which are inter-connected. Bulk supplies were transmitted to seven distribution stations and low pressure supplied from these stations to the respective districts. Bulk supplies were given from the high pressure system to two other undertakings.

High pressure mains are laid from Uddingston and Cambuslang as follows:

(a) From Uddingston under separate directional mains to
  (i) Bellshill, Holytown, and Carfin, extending to about 6½ miles, and
  (ii) Larkhall and Stonehouse, extending to about 11½ miles.

(b) From Cambuslang to
  (i) A point connecting with the high pressure main from Uddingston, a distance of about 4.9 miles. (This main supplied Blantyre and subsidiary districts.)
  (ii) A connection taken, from the high pressure main, to East Kilbride, a distance of 4.1 miles.

The inter-connection between the manufacturing works allowed the high pressure loads to be balanced as required between the works and had also proved invaluable for transferring gas loads when structural schemes or repairs have been in progress at the respective works.

Mr. **J. M. Dow** (Paisley) said whether or not it was a good thing to distribute 35% of the daily gas output through a high pressure supply system was something which could only be answered after all the local factors were known, and a balance struck showing the capital, maintenance, and running costs of the high pressure system against the capital and maintenance costs of developing the low pressure feeder mains. What must not be lost sight of in assessing the work of those early Dundee pioneers was the fact that much of their work was of an experimental nature. Without their initiative the industry would be not nearly so well informed on a subject of very great moment at the present time.

Few of them had not, at some period of their careers had to give some thought to a scheme to supplement supply pressures in suburban areas. Unless low pressure systems had unjustifiably large mains in every street, it would be found as the load increased that in certain locations pressure conditions varied. It was doubtful if those variations could be corrected satisfactorily by supplementary boosting of the low pressure mains at the production centre, especially if the areas affected were in the suburbs and were remote from the gasholder station. Like the Dundee undertaking, many had found that the only satisfactory method of remedying faults of this nature had been to adopt some form of high pressure distribution. By so doing they had not only saved their undertakings considerable capital cost, but had greatly increased the flexibility of the distribution system. They had reasoned logically a saving in service maintenance due to the partial elimination of moisture and gum from the gas before it reached the consumer's service; and, moreover, adequate pressure in the service pipe meant better control at the appliance.

On the other hand, he imagined some of them asking, 'What about the unaccounted-for gas factor? Does this not tend to increase with the use of high pressure distribution?' If they were to take the Dundee case as an extreme example, the answer was surely in the negative, the unaccounted-for gas factor returned over the past six years averaging only 4.9%. He could testify to a similar experience in Paisley where during the past two years approximately 20% of the town's gas supply had been distributed through the high pressure ring main. The unaccounted-for gas factor during those two years was 4.08% and 2.57% respectively. The maintenance of a low unaccounted-for gas factor depended largely upon the degree and continuity with which maintenance was carried out.

The growing preference for spun iron over steel for high pressure distribution might have interesting repercussions relative to the life of the main and to finding a solution to the 'dust' problem, although in the case of the latter he was inclined to believe that internal corrosion was largely a matter that could be remedied by the initial choice of a proper protective medium.

All these factors considered, surely the most important lesson to be learned from the paper was that in planning a high pressure distribution system it was essential to look well ahead before determining the size of main and type of plant to be employed. Distance should be no deterrent, provided the initial planning was on sound lines and plant and mains were not required to operate under conditions conducive to bad service and high distribution costs. Distribution costs could easily become a major item of revenue expenditure in many undertakings in the near future, and great care must be exercised by those responsible to provide the best possible scheme to meet the needs of any particular area. Once a distribution system had been established, the decreasing of distribution costs required greater effort, more familiarity with the numerous details, and more trained supervision than were necessary to accomplish the same purpose on production.

Mr. **D. L. Dickson** (Airdrie) said that the Dundee area with its steep hills and valleys provided many problems; those problems had been tackled successfuly. More important in view of high costs was the fact that the same system, by modification and the use of modern methods of control, had not only been adapted to give a much greater output but also arranged to bring into greater use dormant capital assets in the form of district holders, in this way easing the works storage problem by reducing peak loads on compressors and boiler plant. When, as visualised by Mr. Johnston, it was possible to spread the compressor load over 23 hours as against the present 17, many more economies would result and a still further reserve in compressing plant would be made available. The author had mentioned that he proposed to fit a system of remote indication at district stations for stock pressures, &c., with a view to later adoption to remote control when the number of district stations warranted it. Were there any particular reasons why this should not be done now, so far as the Broughty Ferry holder was concerned? His own experience at Kirkcaldy where their storage capacity at peak approximated eight hours and the works site was so congested that no further storage could be laid down, made the position so critical as to warrant the installation of remote filling, indication of stock and pressure, &c., to two district holders, the remote control unit being planned to permit with minimum expense of extension to take in a new district holder when built on a new works site far removed from the town, provision being made to permit the gas from this holder being boosted back into the district. The latter was essential and would permit of the new holder being operated in conjunction with the manufacturing unit despite its remoteness.

It was announced that Mr. Johnston would reply in writing to those who had spoken to his paper.

PRODUCTION OF LUBRICATING OILS*

By I. A. HOWDEN, B.Sc.,
Shell Mex and B.P., Ltd.

ALL crudes do not yield large amounts of lubricating oil, and the residual stock from the preliminary distillation of a highly paraffinic crude does not give appreciable yield of asphaltic bitumen. The residue in this case consists essentially of cylinder stock from which dark cylinder oils and amber cylinder oils are obtained. The amber cylinder oils or bright stocks are obtained by filtering the dark or steam refined cylinder oils through activated earth such as Fullers earth and removing by a dewaxing process the paraffin wax which is usually present.

The terms asphaltic, paraffinic, &c., which are applied to different crudes can be very misleading and the fact that a lubricating oil is produced from an asphaltic base crude does not mean that it contains asphalt. Asphalt is separated from the oil by distillation and subsequent refining.

Distillates are usually graded according to their viscosity, the lowest viscosity oils being spindle oils which are the lightest fractions from the distillation and the highest viscosity oils being heavy machine oils which contain the high boiling fractions. The viscosity classification usually refers to the viscosity of the oil at 100° F. as determined by the Saybolt viscometer. For example a 300 pale distillate is a pale distillate of viscosity approximately 300 seconds Saybolt Universal at 100° F. and a 1,100 red distillate is a red distillate of viscosity approximately 1,100 seconds S.U. at 100° F.

On the other hand cylinder oils are classified according to their flash point or fire point. For example 600 Penna S.R. signifies a dark steam refined Pennsylvanian cylinder oil with a fire point of 600° F. approximately.

Blending

While the oils as produced by the refinery are often marketed straight—*i.e.*, without blending—it is often necessary to blend the refinery products. A refinery normally produces three or four fractions or 'cuts,' and, by blending, oils of intermediate viscosity or blends containing both distillates and bright stocks can be made available. Bright stock is generally introduced to improve the heat-resisting qualities of a lubricant, and to increase the viscosity, but as bright stocks are residual oils they may increase carbonising tendencies. Mineral oils are often blended with fatty oils in order to improve their emulsifying properties. An example of this is the use of blown or thickened fish oil and rape-seed oil in lubricants used for marine engine bearings. Of recent years, considerable advances have been made in the use of certain chemical additives to improve the characteristics of mineral oils for specific purposes—*e.g.*, oxidation inhibitors for turbine oils and detergent additives for diesel engine oils.

Greases

Lubricating greases are semi-solid lubricants which consist essentially of mixtures of soap and mineral oil. The soaps are formed by the action of alkalis such as lime, caustic soda, &c., on fats such as tallow, lard, wood grease, and fatty acids —*e.g.*, oleic, stearic, palmitic, and others. Certain greases can also be made by dissolving commercially prepared soaps—*e.g.*, aluminium stearate—in mineral oil. The general procedure in the manufacture of a grease is to mix the fat or fatty acid with part of the mineral oil and then to add slaked lime or caustic soda solution. When formation of the soap is complete the mixture of soap and oil is run into the remainder of the mineral oil and stirred until the correct consistency is obtained.

Lime base greases differ essentially from soda base greases in that the former are insoluble in water while the latter are disintegrated by water owing to the fact that soda soaps are water-soluble. They also differ in drop point (sometimes loosely referred to as melting point). Lime base greases generally have drop points of 100° C. approx. and soda base greases 150° C. approx. Lime base greases with drop points as high as those of soda base greases have, however, been produced. Lime base greases also tend to possess a smooth or short structure, while soda base greases have a spongy or stringy texture. It should, however, be pointed out that soda base greases with consistencies similar to those of lime base greases can be produced by selecting a suitable fat or fatty acid and milling the final product.

Mineral oils consist of a complex mixture of hydro-carbons and it is not possible to assess their qualities by purely chemical tests. A number of arbitrary tests have been designed, therefore, for measuring the suitability of a mineral lubricant for any particular purpose, and as these tests are of an arbitrary nature the conditions under which the tests are carried out are carefully specified. (A.S.T.M. and I.P.) The generally accepted methods of test are as follows:—

Specific Gravity

This is determined direct by hydrometer. When the first crudes were discovered, specific gravity bore a definite relation to viscosity, and in any single crude today the higher the specific gravity of any fraction, the higher the viscosity. No relation exists, however, between specific gravity and viscosity in oils from different sources. For a considerable period the specific gravity, in conjunction with other tests, was an indication of the origin of an oil, and it still remains so to a certain extent. With the advent of solvent refining processes and the considerable reduction in specific gravity brought about by the refining process, specific gravity can no longer be regarded as a measure of quality. A possible exception is in the case of superheated steam cylinder oil where Penna oils of low specific gravity have been generally accepted as the most satisfactory lubricants for reasons which will be given later. Specific gravity cannot, however, be said to represent in any way the lubricating value of an oil and is gradually being omitted from commercial specifications.

Flash Point

This may be described as the temperature at which vapours given off by a given volume of oil when heated in a standard apparatus ignite momentarily when brought into contact with a flame (Pensky Martens apparatus). In an engine oil it is to some extent a measure of quality in that a low flash point usually denotes a more volatile oil, and as the more volatile constituent evaporates the oil thickens and may become useless for service. In oils used for metal treatment such as quenching, a low flash point is undesirable owing to fire risk. It is sometimes stated that low flash point oils are the cause of explosions in air compressors, but this is not so, as the spontaneous ignition temperature is more important in such cases. (The S.I.T. is the temperature at which a combustible substance can ignite spontaneously without application of any external source of ignition, as in diesel engines). Generally speaking, the S.I.T.'s of petroleum products are in inverse relation to the flash points. For steam cylinder oils, the flash point is of importance. Steam cylinder oils are residues, not distillates, and the degree of concentration is reflected in the flash point. For superheated steam the more concentrated residues and therefore those with higher flash points should be used.

* From a paper to the Northern Junior Gas Association, Sept. 2, 1949.

Viscosity

The viscosity of a fluid is its resistance to shear (or flow) and is expressed fundamentally as the force needed to shear an oil film of unit thickness at unit speed. In commercial practice a number of standard instruments are used to give comparative viscosities. All these depend upon the rate of flow of oil through an orifice of standard size. In this country we use the Redwood viscometer. America use the Saybolt and the Continent Engler. The results are expressed as the time taken in seconds for a given volume of oil to flow through this standard orifice. Viscosity is probably the most important individual property to be considered in the selection of an oil for any purpose. Correct lubrication from the viscosity point of view is to use the thinnest oil which will maintain a film and give an adequate factor of safety under the conditions of use. The use of an oil heavier than is necessary will result in loss of power by reason of excessive fluid friction. In selecting lubricants the viscosity must, for obvious reasons, be considered at temperatures having a relation to those likely to be met with under particular conditions of use. Lubricating oils vary in viscosity with change in temperature but they do not all vary to the same degree. For example, taking two oils A and B with the same viscosity at 140° F., oil A may possess a lower viscosity than oil B at 70° F. and a higher viscosity at 200° F. Oil A is then said to possess a flatter viscosity curve than oil B.

The S.A.E. in America has standardised the viscosities of automotive and diesel engine lubricating oils in terms of the Saybolt viscosity, the oils being number from 10 to 70 according to the viscosity. The S.A.E. classification is purely a viscosity rating and is no guarantee of quality.

Pour Point

This test measures the temperatures at which an oil ceases to flow under specified conditions. It gives no information as to what happens when the oil, for example, is poured from a can—that is, when it has a considerable weight of oil behind it. Also, it only indicates that at a definite temperature a waxy structure develops in the oil which interferes with its flow, but it does not give any information about the properties of the oil when it has been agitated to such an extent that the wax structure is broken. There are methods in use where a standard pressure is exerted on a column of oil at low temperature and the time taken for the oil to move a certain distance is measured.

Saponifiable Matter

The percentage of saponifiable matter in an oil is the percentage of added fatty oil. Compounding is claimed to improve 'oiliness,' and it is true that fatty oils, by virtue of the fact that they contain, or can easily produce, a small proportion of free fatty acid, are more adhesive to metal surfaces than pure mineral oils. Further, fatty oils are more emulsifiable with water than mineral oils and are therefore useful constituents of marine engine oils where it is essential that the lubricant shall not be washed off the surface to be lubricated by water leakage or by salt spray. Fatty oils are also good solvents for tarry impurities such as are sometimes found in gas engines in the case of faulty scrubbing of the gas. On the other hand, they are in general more easily oxidisable than mineral oils and under extreme temperature conditions they may cause thickening of the lubricant, carbonisation, and increase of fluid friction. The properties of fats, therefore, should be considered in the light of the particular plant which has to be lubricated.

Demulsification Value

Certain lubricants which are used in turbines and enclosed crankcase steam engines come into intimate contact with steam and water, and it is necessary, therefore, to apply a suitable test to these oils which will evaluate their readiness to separate from water and not form troublesome emulsions, with loss of lubricating value. The majority of such tests consist of passing saturated steam into the oil under specified conditions and measuring the time taken for the resultant emulsion to separate into oil and water layers.

Oxidation Tests

These tests are designed to measure the stability of an oil under oxidising conditions—for example, when a lubricating oil at high temperatures is in contact with air or oxygen. Such oxidation causes oil to thicken, as in the case of linseed oil in varnishes and paints. The British Air Ministry Test is the best known method and consists of heating the oil to a high temperature and bubbling air through it under standard conditions. A carbon residue determination is carried out before and after oxidation and also the ratio of the viscosities at 100° F. before and after oxidation. This ratio gives an indication of the extent to which the oil has thickened by oxidation. The test is of somewhat doubtful value as the artificial conditions are usually much too severe owing to the desire to obtain definite results in a short time. In actual service, lubricating oil is subjected to an infinite variety of oxidising conditions and therefore no test under a standard set of conditions can be expected to correlate with practice. One disadvantage of the B.A.M. test is that it was designed for high viscosity aircraft oils and if applied to lighter oils tends to give anomalous results owing to volatilisation of the lighter portions of the oil at the temperature of 200° C. reached in the test. An artificial figure for the amount of thickening due to oxidation is, therefore, obtained. Recently, less stringent oxidation tests have been designed, more particularly for the evaluation of turbine oils, and in these temperatures of 130°-150° C. are used, water and metal catalysts being present. Air or oxygen is used as the oxidising agent. For diesel engine and petrol engine oils there has been a tendency to discard such tests in favour of more practical tests, for example the G.M. Diesel 500 hour test, where a satisfactory oil is required to show no bearing corrosion, ring-sticking, scoring of cylinder liners, or excessive deposits under a standard set of test conditions. Another test with the same end in view is the Chevrolet 36-hour endurance test.

Melting Point

A lubricating grease does not possess a true melting point, but the dropping point can be measured in the following manner. A small tapered glass cup, open at both ends and filled with the grease under test, is secured by spring clip to a thermometer, the bulk of which is immersed in the grease. The thermometer, &c., is contained in a glass boiling tube and the whole gradually heated in a water or oil bath. With rising temperature, the grease softens and eventually a drop of grease or separated oil falls to the bottom of the jacket. This is taken as the drop-point. It is not the true melting point but gives a satisfactory indication of the temperature at which a grease becomes too soft to be suitable as a solid or semi-solid lubricant or at which oil separation takes place.

Users of industrial lubricants have the option of three general methods of buying lubricants:—

1. By chemical specification.
2. By machine manufacturers' recommendation.
3. By asking the advice of an oil company.

The first method, that of buying to specification, is quite suitable for less critical lubrication but cannot be recommended for specialised lubrication for machines such as turbine and diesel engines.

You may, therefore, decide to use the second method. Take the advice of the machine manufacturer on matters of lubrication. When an isolated machine is in question this is the most satisfactory way of solving the difficulty. The manufacturer of the machine has obviously given the matter some considerable study and his advice will be thoroughly reliable. But you will not usually be interested in one isolated machine but a large number of machines by different manufacturers, and if the advice of each is taken, the result will be a variety of different oils and an extension to the stores department.

This is where the third method mentioned will pay dividends. If you call in the services of a reputable oil company and show your machine to their lubrication engineers they will be able to advise you on the best and most economical lubrication. Economical does not necessarily mean buying the cheapest oils but buying a good oil at a reasonable price which will give reasonable consumption with low wear.

PLANNING OF STREET LIGHTING FOR A PROPOSED NEW TOWN*

By W. H. WELCH,
Eastern Gas Board (Tottenham Division)

***EDITOR'S NOTE:*—The public lighting engineer seldom has the opportunity of planning the street lighting of a completely new town. Harlow (Essex), however, is one of the new towns in the Government programme which appears to offer such an opportunity. The author, making use of such information as is to hand about the Development Corporation's master plan, outlines his suggestions for a scheme complying as far as possible with the recognised practices and principles of public lighting. The installation suggested is all-gas, the author being a lighting engineer attached to the Tottenham Division of the Eastern Gas Board.**

IN the case of Harlow, the first step was to get in early with a claim to provisional sites for proposed public lamps, thus leaving the way clear for a straightforward erection of columns as and when required. Most people will agree, though, that things are not likely to work out that way. It may be assumed that the erection of the houses, &c., will follow conventional practice and that the first stage will be the construction of roadways with the building of adjacent properties to follow. This by-passes, for the time being, the construction of a permanent footpath. The public utility services, well to the fore, usually have their mains laid long before there is any sign of a permanent footpath.

The detailed location of these various mains is not of paramount importance and in no time the approximate line of the proposed footpath is truly occupied. The minimum distance normally required from the face of the kerb to the back of the column for the 13-15 ft. columns erected in Group B roads would be somewhere about 2 ft. 6 in. and for the 25 ft. columns on the Group A roads an average of 3 ft. Thus it may be seen that clear margins of the widths mentioned above left in the footpaths for the provision of lamp columns would be of immense help to the lighting engineer.

An Unattainable Ideal

In theory, one would say that the only way to make sure of the columns being erected just where they should go would be to obtain the necessary kerb lines and levels and erect them just as soon as the roadways are laid down, although in actual practice this would not be possible. As is well known, the ground adjacent to the carriageway is considered just the spot to unload and dump stacks of bricks, ballast and the many miscellaneous materials required on a building site. Transport of all types is constantly up and down and for that matter on and off the carriageway and the amount of traffic damage to the columns in all probability would be considerable.

It is also none too easy to guarantee that the preliminary detailed layouts of the various sites as shown on the plan will be those which ultimately materialise and as it is necessary to bear in mind the exact position of front gates, garage crossings, shop blinds and so forth, one cannot be too careful when installing the lamps. It is unlikely that the layout would be completed without further amendment and this would mean shifting some of those columns which had been erected already.

The lighting visualised is not necessarily that which will be installed when it is completed. It has been prepared for illustration purposes only and without any reference whatsoever to the Harlow Development Corporation and both the installation and the covering remarks must be accepted as being based, in the first instance, on the types of lighting which the author would like to see installed and, secondly on installation difficulties encountered in the past. The Harlow Development Corporation has been extremely co-operative and has afforded me every facility to use the proposed layout. It obviously cannot be stated, however, in what way the suggestions could be put into practice as in that respect the author has not had and possibly will not have any direct dealings with the development authorities. In any case, it is likely to be some considerable while before the town will have progressed sufficiently far for street lighting to be installed.

The town on which the paper is based has a designated area of 6,320 acres, being roughly 3¼ miles from north to south, and 4½ miles east to west across its widest parts and will eventually cover what is at present largely agricultural land. There are at the moment existing residential areas and housing but these are widely scattered over the future site and can be ignored from the point of view of existing lighting.

Proposed Amenities

Certain agricultural areas on the fringe of the new town will remain. To the north-west and north-east respectively will be industrial areas. The town buildings will literally be in the centre of the town with the residential areas evenly spaced around it and the various primary and secondary schools evenly distributed among the residential properties.

Provision is also being made among the various civic amenities for the following, all of which will need to be adequately lighted: 'Bus station, civic centre, shopping centre, market place, car parks, &c.

Various radial and orbital roads are planned to skirt the town and from these other radial roads will traverse the town itself. From these in turn will run the normal major and minor town roads, not forgetting those which are already in existence. Hundreds of lamps will be required and it is hoped that the scheme outlined here will be of use to other lighting authorities faced with a similar problem.

It is not proposed in this paper to give details of the actual position, &c., of the lamps suggested for the installation. These would, of course, be sited to conform with current practice, the positions being normally governed by the recommendations contained in the Final Report of the Ministry of Transport Departmental Committee on Street Lighting.

Coming to the types of lighting considered to be most suitable for the various Group A and Group B roads which cover the new town, it is found that the range from which to choose is considerable and the point arises whether or not to standardise as far as is possible with the minimum number of types or to have a variety of fittings in different sections of the town. With regard to the Class A roads, the author is of the opinion that it would be preferable to carry out the former arrangement with possibly two types of lamp only and on the Class B or minor roads prefers to some extent rather more freedom of choice. This, of course, would be governer by the type of locality in which the lamps would be fitted and in any case does not necessarily mean a large variety of lamps would be used, bearing in mind the fact that standardisation is an important factor in an economic maintenance system.

* From a paper presented to the Association of Public Lighting Engineers, Llandudno, Sept. 15, 1949.

Taking in the first instance the lamps for main traffic routes or shopping centres, one could not do better than to install lamps of the type shown in Fig. 1. This lamp would be fitted with 12 No. 2 mantles and fixed at a mounting height of 25 ft. It is fitted with reflector plates specially designed to give even road surface brightness and good visibility without excessive glare and the oval prisms used give a lateral spread to the light distribution which is of great benefit in the lighting on bends and in open spaces. The form of construction of the lamp facilitates maintenance and the burner operates on the dual injection principle which eliminates any possibility of it lighting back to the gas ejector.

FIG. 1

The lamp is constructed in two units, each unit with its own burner which may be independently controlled to give a partial extinguishing of the lamp at a given time should this be desired. The lamp may also be obtained built as a single unit for use where the standard of lighting required may not be as high as that on a trunk road but higher than that required for, say, a market place. It would be ideal for use in one of the industrial zones of the new town.

FIG. 2

As an alternative, the lamp shown in Fig. 2 is a representative example of a high power low pressure gas lamp once again fitted with 12 No. 2 mantles. In this case, the distribution of light is not achieved by refractor plates, but by a very flexible system of specular reflectors of mirror glass, which have a special heat resisting electro-deposited backing. The reflector system controls the light very effectively ensuring that it is most usefully employed and is easily adjusted to suit the varying conditions imposed by the geometry of the road.

The usual practice in the case of dual carriageways with a wide centre reservation is for each road to be treated as a separate highway with an independent lighting installation. It has been found that in certain dual carriageways satisfactory results can be obtained on each carriageway by using a single line of lamps mounted above the centre verge some 90 ft. apart with a cut-off reflector system. The lamp mentioned in Fig. 2 is adaptable for this purpose and the author would certainly consider it for the lighting of any dual carriageways connected with the new town. Both lamps would be mounted on steel columns, this being purely the personal choice of the author. It will be appreciated, of course, that the final choice of both columns and fittings would rest with the lighting authority.

The lamp shown in Fig. 3 is suggested as representative of the type of lamp most suitable to meet the varying lighting requirements in a residential area. It is of neat appearance and simple construction and gives an adequate road surface

FIG. 3

brightness with an absence of glare. The parabolic glass reflector system is again very flexible and is easily adjusted to suit conditions in the road being lighted, taking into account bends, 'T' junctions and the like. The light source itself is highly efficient and is easily and cheaply converted to a higher or lower powered unit as may be required by the simple expedient of changing the gas nipple and subsequently the size and/or number of the mantles and nozzles. It may be seen, therefore, that the standard lamp may be used to cover the varying lighting needs of a number of Group B roads. The lamp shown in the photograph has a mounting height of 14 ft. 6 in. and is mounted on a cast iron column. Owing to its design is will quite easily light the forecourts and fronts of buildings in addition to the carriageways and footpaths.

For those who prefer the lamp mounted on a concrete column, Fig. 4 shows it available as a complete unit fixed to an artistically designed concrete column with a bracket giving an overhang of 1 ft. 2 in. and a mounting height of 13 ft.

The author would chose for the quieter areas of the town the fitting shown in Fig. 5, the 'Tudor' type of lantern which

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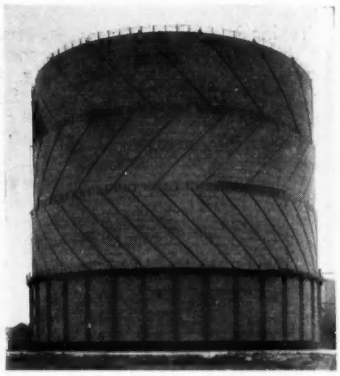

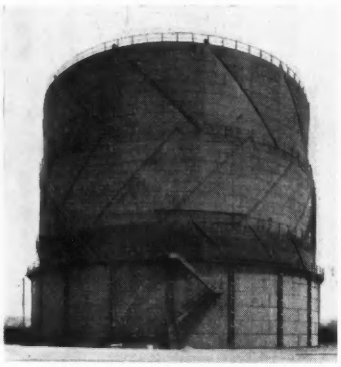

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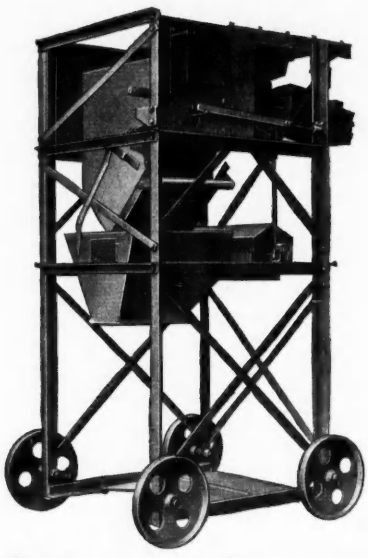

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is especially suitable for those districts where the architectural features demand the installation of street lanterns of less modern design. The lamps would be fitted with three No. 1 or bijou mantles normally in alignment, and mirrored glass reflectors. At a mounting height of 14 ft. the unit gives an extremely satisfactory performance.

Lamps contemplated by the author for the new town would be fitted with independent clockwork time switches, each having a run of approximately six weeks before being in need of rewinding. The time switches would be fitted with solar compensating dials which would permit of the lighting and extinguishing times for the lamps being automatically varied daily to fit in with the variation of the actual times of sunrise and sunset. This would mean that the period between sunset and lighting up time and sunrise and extinguishing time would be constant.

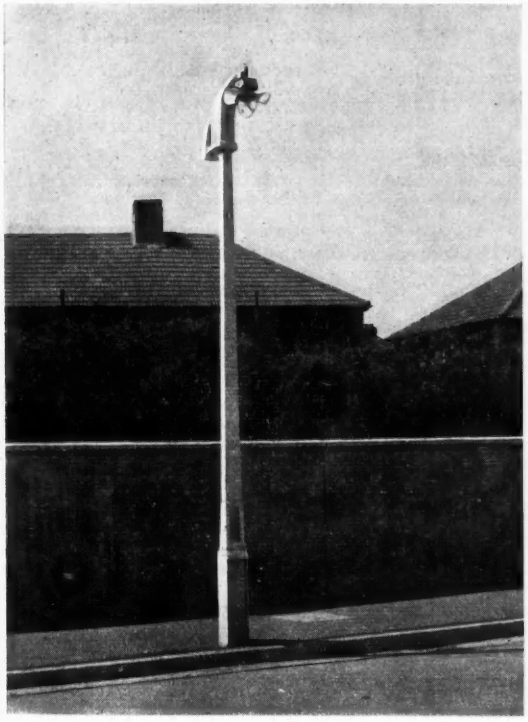

FIG. 4

One of the most important factors to be considered even before the installation is completed is the provision of a first class maintenance service. An installation of new equipment is theoretically all that could be wished for, but the initial efficiency of that installation soon begins to fall off without a reasonable amount of care and attention. Assuming that the tender is accepted by the lighting authority for the provision of a certain standard of 'lighting' in the streets, it should be a point of honour with the contractor to allow in his maintenance charge for the highest possible standard of efficiency from the equipment installed, with considerably less tolerance than seems to be expected in a good many quarters nowadays.

The maintenance agreement would allow for a set standard of lighting with a tolerance clause of no more than 30%. Some people will no doubt challenge this figure, but it is not an unreasonable one to offer and an efficiency of 80% can be maintained. The lighting authority would be given the right to have any part of the installation independently tested.

A penalty clause, containing certain necessary and reasonable safeguards for the contractor, would be included in the agreement and should be enforced if it became necessary by the administrative authority. This is an important factor and one which would help to improve the general standard of street lighting throughout the country if it were applied more often. The penalty clause would also allow for there being no lamps left out of lighting at any time unless there be some good reason beyond the control of the supply authority. Every lamp in every street, public footpath, or any other place to be lighted at public expense, would be inspected every evening and any found to be not alight would be serviced immediately.

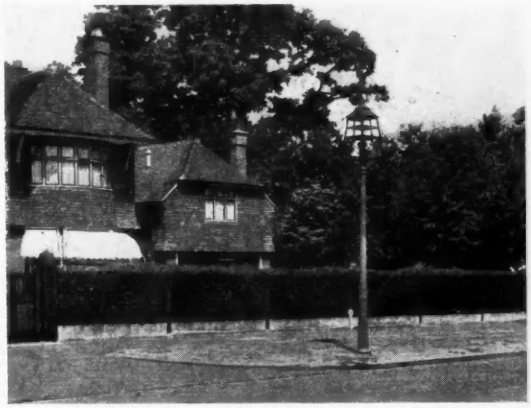

FIG. 5

The staff engaged on the actual maintenance of the lamps would be men thoroughly trained in the gas industry and not casual labour recruited from the employment exchanges and offered jobs as 'lamp lighters.' It is essential that the man engaged on the job should have a good sound knowledge of the work which is expected of him and there is every facility within the industry for the necessary experience to be acquired. One cannot expect the high standard of workmanship from the untrained employee which is so necessary if the efficiency of the installation is to be maintained.

With regard to the general maintenance such as cleaning and routine inspection, this would be carried out according to a regular schedule. The frequency with which this work would be necessary would be governed by a variety of factors such as the season of the year, the hours of lighting and the degree of atmospheric pollution in the vicinity of the lamps, all of which affect to some degree, their efficiency. The maintenance requirements would also vary with the different types of lantern and particularly glassware in use. It is essential that a regular comprehensive maintenance schedule be drawn up and strictly adhered to. It is the only way in which a guaranteed lighting service would be maintained and the maximum benefit obtained from the equipment installed.

The Building Research Station's Scottish Laboratory at Thorntonhall is now partly completed, and a nucleus of staff have begun work. In connection with this development a one-day conference on 'Scottish Needs in Building Research' is to be held on Oct. 6, in the Rankine Hall of the Institution of Engineers and Shipbuilders in Scotland, Glasgow. Lord Morrison, Parliamentary Secretary of the Ministry of Works, will preside, and the chair at the afternoon session will be taken by Mr. W. K. Wallace, Chairman of the Building Research Board of the Department of Scientific and Industrial Research. The principal paper in the morning session will be given by Mr. L. W. Hutson, President of the Royal Incorporation of Architects in Scotland on 'The Scottish Tradition in Architecture and Building Construction.' In the afternoon there will be a discussion on 'Special Problems of Building in Scotland,' in which a number of speakers representing the various sides of the industry are to be invited to give a short statement of their views.

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North Western Prices

At a meeting of the North Western Gas Consultative Council, held in the Manchester Corporation gas showroom theatre, on Sept. 27, the Chairman, Councillor C. E. P. Stott, J.P., read a communication from the Chairman of the Gas Board, Colonel W. M. Carr, O.B.E., intimating that the board had put into operation as from June last revised prices of gas in respect of 12 undertakings, adjusted discounts so as to effect an increase in two undertakings, and price reductions in two other undertakings. The board has now presented 21 undertakings for price revision, and there are five undertakings where sufficient information is not available to warrant reaching a decision at the present juncture. There are outstanding 61 undertakings where it is not proposed to revise the prices at the present moment.

The Board has approved the grouping of the 103 undertakings into 17 administrative groups.

Following this meeting, the North Western Gas Board has announced increases in the prices charged for gas in the areas supplied by 21 of its constituent undertakings. Ranging from 0.4d. per therm to 2.25d. per therm, these increases follow increases announced in July in respect of 12 undertakings in the North West area, cash discount reductions in respect of two, and price reductions in respect of two others. Taken together, the price increases announced by the North Western Gas Board since vesting date affect three-quarters of a million consumers, served by 33 undertakings, out of a total of 1,600,000 consumers served by 103 undertakings.

Prices have been increased only in those areas where the undertakings have been operating at a loss or where sufficient provision was not made prior to vesting date to meet increased costs of coal and other materials. Each undertaking has been considered individually, and the increases have been limited in each case to the minimum necessary to correct the individual undertaking's actual or anticipated losses. In a number of cases the increases imposed are not in themselves sufficient to make good such losses. It is hoped by technical measures and economies arising out of the new structure to fill the gap in these instances.

The new prices are shown in the following list with the old prices in brackets :

Barrow-in-Furness, 12.803d. (11.303d.); Birkenhead, 13d. (12d.) and outer area differential abolished ; Blackburn, 14.5d. (13.529d.) and outer area differential abolished ; Buxton, 13d. (11d.) ; Chester, 13d. (11.6d.) and outer area differential abolished ; Colne, 13.5d. (12.85d.) ; Dalton-in-Furness, 17d. (15.33d.) ; Hayfield, 16d. (14.2d.) ; Hoylake, 15d. (13.33d.) ; Lancaster, 15.74d. (14.74d.) ; Liverpool, 14.5d. (13d.) ; Millom, 17d. (16d.) ; Nelson, 14d. (13.6d.) and outer area differential abolished ; Newton-le-Willows, 14d. (13d.) ; Oldham, 13d. (11.579d.) and complicated tariff simplified ; Oswaldtwistle, 14.5d. (13.3d.) ; Rochdale, 15.5d. (14.6d.) ; Salford, 15d. (14.05d.) ; Thornton-Cleveleys, 16d. (14.45d.) ; Widnes, 12d. (10.11d.)—cash discounts reduced to 2½% and outer area differential abolished ; Wallasey, 14.5d. (12.25d.).

The Scottish Gas Board has announced the following price increases affecting five undertakings :—

Airdrie, an increase per therm of 0.588d. ; Inverness, 1.364d. ; Buckhaven and Leven, 0.706d. ; Galashiels, 0.476d. ; Hawick, 0.714d.

Gas Valuations

Valuations of 48 more securities of 16 companies appear in the following list—the 10th—published by the Ministry of Fuel and Power on Sept. 29. Stocks of some South Coast undertakings, such as Broadstairs and Dover, which suffered heavily from war damage or loss of revenue from war causes, are included. In common with those stocks published in the *Journal* last week, the conversion date has been deferred until after Oct. 31 in view of the payment of interest on British Gas stock on Nov. 1. There now remain only two large companies whose securities await valuation—the Gas Light and Coke Company and the South Eastern Gas Corporation. Securities shown below are in units of £100 unless otherwise indicated.

Company	Compensation Value
Broadstairs 5% Perp. Deb.	£125
Do. 4% Perp. Deb.	£102
Do. 5% Pref.*	£112
Do. Consol.*	£130
Colchester 6% Pref.	£133
Do. Orig. Ord. (£20 unit) ...	£42
Do. New Ord. (£20 unit) ...	£30
Deal and Walmer 4% Red. Pref.* ...	£100/10/-
Do. Ord. Cap.*	£120
Dover 5¼% Perp. Deb.	£130
Do. 4% Perp. Deb.	£103
Do. 3½% Perp. Deb.	£99
Do. Consol. Cap.*	£170
Do. New Ord.*	£170
Do. Ord.* (£10 unit)	£17
Do. Ord.* (£5 unit)	£8/10/-
Exmouth 5% Consol. Pref.	£112/10/-
Freshwater 4½% Red. Pref. (£1 unit)	20/2
Do. Orig. Ord. (£5 unit)... ...	£8/15/-
Do. Addl. Ord. (£5 unit) ...	£6/5/-
Long Sutton and Sutton Bridge Ord. (£10 unit)	£9
Portsmouth and Gosport Consol.† ...	£157
Ridings 4% Consol. Deb.	£102
Do. 5% Pref.	£112/10/-
Seascale Ord. (£1 unit)	20/-
Stamford and St. Martins 7% Pref. ...	£150
Do. 5% Pref.	£112
Do. Consol.	£275
Sudbury 6½% Pref. (£1 unit)... ...	27/6
Do. Orig. Ord. (£1 unit)... ...	35/6
Swansea 4% Perp. Deb.	£102
Do. 3½% Perp. Deb.	£98
Do. 3½% Red. Deb. Bonds (all redemption dates)	£100/2/6
Do. 3½% Red. Deb. Bonds (all redemption dates)	£100
Do. 3½% Red. Deb.	£100
Do. Ord.	£92/10/-
Swindon 5% Perp. Deb.	£126
Do. 5½% Pref.	£127
Do. 4½% Pref. (£10 unit) ...	£10/18/-
Do. 4½% Red. Pref. (£1 unit) ...	20/8
Do. 4% Red. Pref., 1965... ...	£100/10/-
Do. 4% Red. Pref., 1955-65 (£10 unit)	£10
Do. 4% Red. Pref., 1970 (£10 unit)	£10/1/6
Do. Consol. Ord....	£142
Thirsk 5% Irred. Deb.	£125
Do. Orig. Ord. (£10 unit) ...	£11
Do. Addl. Ord. (£10 unit) ...	£11
Woodhall Spa Ord. (£10 unit) ...	£11/13/4

* The value of these unquoted securities has been determined in accordance with Sections 25 (10) and 26 (4) of the Act.

† The value of these quoted securities is the value for the purposes of Section 25 (2) of the Act as increased by direction of the Minister in accordance with Section 26 (1) of the Act.